PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, Room 28, Hathaway Building, 620 Atlantic Ave., Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

IN CLUBS of four or more, $2.50 a year each; with a free extra copy to the getter up of a club of 8. Foreign subscription, $6 a year.

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VOL. XVIII. NEW YORK, AUG. 8, 1891. No. 6.

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The Telegraph and the Press. FEW persons realize the immense amount of carefully organized work that is necessary in the publication of a modern newspaper, and fewer still the part that a systematized telegraph service plays in it. The abstract of a clever article by Mr. W. H. Smith, manager of the Associated Press, may, therefore, be somewhat of a revelation to those of our readers who are interested in other branches of electricity than telegraphy. The evolution of the telegraphic press dispatch service from the agreement entered upon by a few papers in 1851 has been something enormous. A hundred thousand words a day are sometimes handled by the New York Associated Press of to-day and the bulk of the matter is placed in a few hours before the public. One might almost look upon the organization as a great wholesale news house with agents in every part of the country, distributing the day's history to be retailed by the daily papers to the public. Perhaps in the next century we may have the same facts distributed by a gigantic phonograph and repeated over long-distance telephones in our houses; but until then we have great reason to be proud of the splendid efficiency of our present means of transmitting intelligence.

Long-Distance Power Transmission. A CORRESPONDENT of one of our esteemed contemporaries suggests the propriety of attempting the long-distance transmission of power from Niagara Falls to Chicago at the time of the coming exposition in 1893. We have not the least desire to detract from the interest of his proposition, or to reflect upon his ingenuity, but we have already put ourselves on record in the matter in an editorial in THE ELECTRICAL WORLD of April 18, and had indeed discussed the matter with Chief Barrett, of the Electrical Section. We are pleased, however, to know that the same idea has occurred to others, and hope that something substantial will come of the suggestion. It would indeed be a magnificent demonstration of long-distance power transmission; and there is not the slightest reason why the scheme should not prove a thorough success, in view of the experiments already tried abroad and the success that has been attained. Really, the only serious question is the financial one, and through the enterprise of our American engineers and manufacturers this certainly ought not to constitute an insurmountable obstacle. The possibility of using enormous voltages far, higher than have ever been contemplated hitherto, gives promise of working success even at a distance so great as between Niagara Falls and Chicago. We are just beginning to realize what can be done by the employment of high-tension alternating currents, and the next decade will show results to surprise even the most sanguine engineers. It probably will never be necessary to attempt the transmission of power over distances of hundreds of miles; but the cases are many where 20, 30 or 40 miles from a manufacturing centre may be found admirable water powers that might be and should be utilized for the furnishing of electric power. Already something in this line has been accomplished, and experiments such as that we have suggested for 1893 would give an impetus to this class of work that would not lose its force for many a year.

Telephone vs. Telegraph. A LITTLE article on a new type of telephone cable elsewhere in our columns gives some very suggestive hints as to what may be done in the near future by long distance telephony. It is shown that the limit of successful conversation may be considerably increased, as has long been known, by the employment of improved conductors, and we may mention here that the Hunnings transmitter is probably not at all the best form that can be devised for long distance work, as was shown in the recent experiments over the London-Paris telephone line. The real obstacle to successful long distance work, to speak paradoxically, is not in the long distance lines, but in the service in the city exchanges. Not long ago we had occasion to call up Boston over our long distance instrument; the operator in the Boston exchange could be heard speaking as distinctly as if one were in the same room instead of over 200 miles away; on connection being made with the Boston office, to which we desired to speak, however, a very different condition of things was noticed; indescribable raking, rattling sounds were heard, and in spite of the fact that both ends of the line had improved long distance instruments, conversation was extremely difficult. This is not an uncommon experience, and shows very effectually the care that has to be taken in the proper arrangement of long distance connections, quite aside from any question of the main lines. Once given a thoroughly successful service between all our large cities, and the telegraph will have a most formidable competitor, not only for ordinary business conversations, but even the dispatching of important press matter. Already something has been done in this line, and the preceding brief remarks are simply intended to suggest to our friends, the long distance companies, the desirability of looking more sharply than ever after their office connections and city lines, thereby taking possession of a very important field, not quite so wide as that of the telegraph, but sufficiently large to prove of great value to them and to the public.

Gas Companies and Electric Lighting. FROM the very beginning of electric lighting our friends the gas companies have taken an apparently fatherly interest in the new industry, and many of them have fallen into line with the march of improvement and equipped themselves with electric plants. Some of these are conducted fairly, honestly and well; others are not. It is to the abuse of electric lighting by gas companies that we desire to call particular attention. This is of two kinds, active and passive; the former consists in operating a plant, usually poor and sometimes grossly mismanaged, for purely cut-throat purposes. First, to furnish lights, even at the expense of dividends, for a price so low as to forbid competition; and, second, to so effectually disgust the public with electric lighting by poor service as to foster the use of gas. Sometimes this amiable tendency is shown by installing arc lights only, at other times putting in small and mean incandescent plants and running at no particular voltage and at inconvenient hours. The passive kind of obstruction is even more annoying. A gas company loudly announces its intention of going in for electric lighting, makes promises of a kind to allure the unsuspecting and obtains an exclusive franchise for five or ten years; then it calmly sits down and does nothing, except perhaps to be more shiftless than usual in the management of its gas service. This is a state of things that exists in a good many small places that would gladly obtain electric lights if possible, but are prevented from doing so by the dog-in-the-manger policy of the gas companies. These are not altogether to be blamed for desiring to suppress competition, for it is a well-known fact that a small gas plant seldom pays inordinately big dividends, even when a considerable price is charged. But in the case of the community it is the duty of the officers of the town or municipal authorities to squelch promptly and vigorously any such attempt at hindering the introduction of the electric light. Poor service is better than none, but no service may be more desirable than a suppression of a good one. If the franchises granted to gas companies were in every case given with a time limit, so as to compel the introduction of the lights or loss the franchise, and were made to include both arc and incandescent lights, many of the difficulties that have been met too often would be successfully avoided. A gas company has just as good a right to electric lighting as any other body, and some capital central stations have been the result of such enterprise, but in the interests of the people at large the authorities should see to it that whatever rights are granted should be utilized, and well utilized.

The Study of Electrical Engineering. WE are constantly in receipt of inquiries from all over the country inquiring about the best ways, both practical and theoretical, of studying electrical engineering. An answer to these is by no means easy, on account of the great diversity in the needs and attainments of those who ask them. It should be borne in mind that electrical engineering is now rapidly becoming a crowded profession. The electrical schools are turning out every year hundreds of clever, well-educated young men who intend to devote themselves to the study of applied electricity. The result of this is twofold—it makes competition rather severe, and the attainment of success by no means easy unless backed by a combination of ability and good fortune. In the second place it makes the task of the electrician who has graduated only from the workshop especially severe. Every profession goes through in its course of growth a series of sudden bursts of activity. Not many years ago civil engineering was the popular study among young men of scientific proclivities. The result was an enormous crowd of bright young engineers who glutted the market for brains for the time being, and by their very numbers made the chances of those who came after them much less than their own had been. It is all very well to quote the old saw that "There is plenty of room at the top," and say that for the young man of ability there is no such thing as a crowded profession. To a limited extent there is undoubtedly truth in these trite observations, but there is little comfort in them for the average man who enters the professions. Sheer ability alone seldom brings any man in professional life to the very front rank, and especially is this true of avocations in which the work is not individualized, as it is in the law and in medicine, but depends on great organizations. Both in civil and electrical engineering the first-class places that can be obtained are not very numerous, and the chances of individual work are lessened in the latter case by the existence of very large companies controlling the bulk of the business. The men who hold the good places, however they get them, are generally active and intelligent enough to keep them, and in electrical work the vast majority of the prominent men are under 40 years of age and consequently look forward to a quarter of a century of active professional life. They are sitting on the top of the ladder and smoking the pipe of peace, while the youngsters may have the privilege of cooling their heels on the bottom rounds. This is not in the least deliberately intended to discourage the study of electrical engineering, but its purpose is to hint to those who contemplate entering that profession that it is well not to raise their expectations of great and immediate success too high. To those who are willing to take up the study of practical electricity in a sensible, hard-headed way, looking on it as a lifework that will constantly interest them and as a means of livelihood at least as good as they are likely to find in business life under our present conditions, we would say, go in and work with every bit of energy you have. You may not get rich or famous, but you will have an honorable calling and a more respectable living than most of your fellow-mortals. The better education you start with the better off you are, but practical experience you have got to acquire somehow, whether you are a graduate of a scientific institute with a long name or not. You will most likely have to take off your coat and do a good deal of dirty, hard work, but it will not hurt you any more than it will any one of your 65,000,000 fellow-citizens. The only advice that we can give that will be of general assistance is to get as good a training as you can afford for the purpose of getting as good a start as may be, then get a foothold—a good one if you can, any sort of one if you cannot; and having obtained it hang on and do straightforward, faithful work.

Latest Foreign Electrical News.

(By cable from our own correspondent.)

LONDON, Aug. 3, 1891.—A large number of municipalities are now taking up electricity more or less seriously. A large proportion of the recent franchises granted have been to municipal authorities, and during the present summer they seem especially active in arranging central stations. The Huddersfield municipality, as we noted last week, has accepted the tender of the Brush company for its work, the expenditure being no less than £21,000 for the central station. The Dublin and Brighton stations are rapidly approaching completion, while in York and Dover the authorities evidently mean business and are pushing the work as rapidly as possible. A large station in Bristol is just now being erected.

The Commissioners of the World's Columbian Exposition at Chicago have interviewed the Lord Mayor of London and the Secretary of State for India, and have received promises of cordial support in making the great British exhibits take the important place which they should in 1893.

Mr. Tesla's important experiments with high frequency alternating currents, recently published in THE ELECTRICAL WORLD, are attracting a great deal of attention from both theoretical and practical men in this country. The subject is so novel and its treatment so thorough that few scientific papers of recent date have been more appreciated.

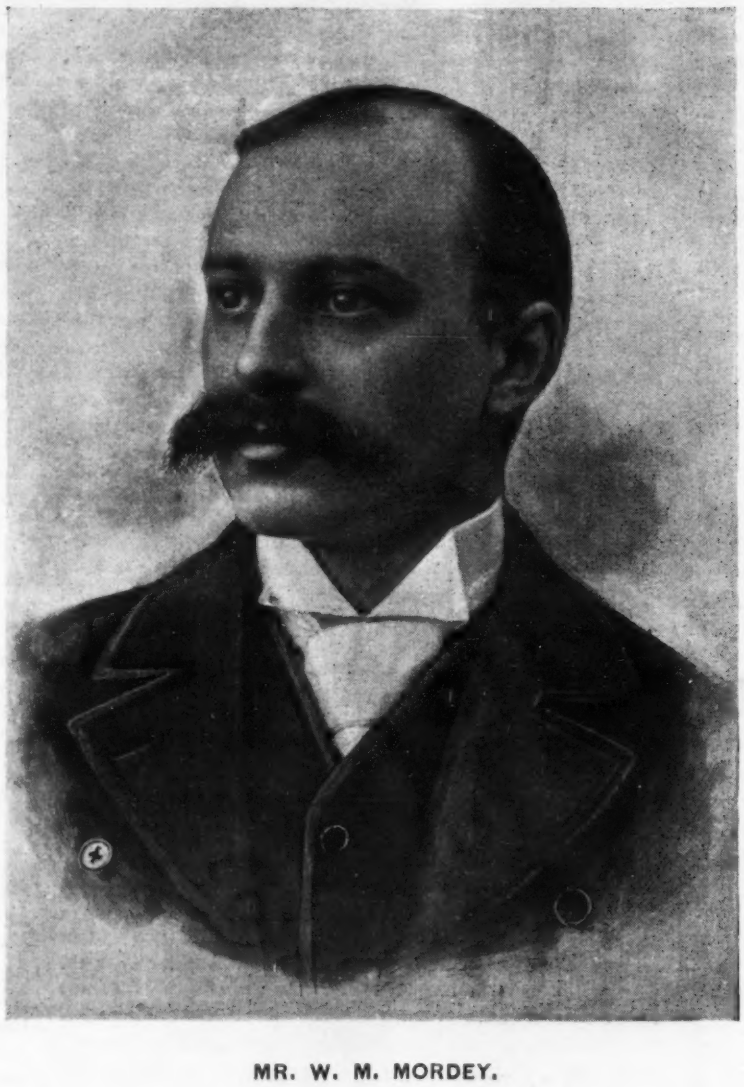
From the continent comes the news that the aluminium steamer, built from metal obtained at the Schauffhausen Works, has now begun running, and is a great success.

ELECTRICAL WORLD PORTRAITS.—XXVIII.

MR. W. M. MORDEY.

Although still a young man Mr. Mordey enjoys the distinction of being one of the most successful practical electricians of the present day. He was born in 1856, and when only 14 years old began his acquaintance with electricity as an operator in the Postal telegraph service. During the next ten years he was steadily at work as a telegrapher, but improved his spare time in the careful study of those branches of physics which would help him in his avocation. He soon became known as unusually well posted in electrical subjects, and finally was asked to conduct the classes formed by his fellow employés for the study of electricity and magnetism; these were under the auspices of the City and Guilds Technological Institute, and proved to be very successful. In 1881, after more than ten years spent in grounding himself thoroughly in practical electricity, he finally left the telegraph service, and obtained employment as an electrician with the Anglo-American Brush Electric Light Corporation, then engaged in exploiting the Brush arc system in England. His experience in the telegraph service had proved so valuable that he was at once appointed superintendent of the testing department in London and continues in that and kindred work up to the present time. Perhaps his first work of importance in the electrical line was the remodeling of the Brush machines, resulting in the evolution of the well known Victoria dynamo, largely used for electric lighting throughout the United Kingdom. In 1883-84 he appeared before the scientific world with some important and intensely practical papers dealing with the construction and management of dynamos; especially a paper before the Institution of Civil Engineers on the arrangements for working compound dynamos in parallel was widely noticed by practical men, and one contributed to the *Philosophical Magazine* in 1886 on the dynamo as a generator and a motor did very much to place motor design on a sound practical basis, although at the time it was diametrically opposed to the opinions advanced by prominent electricians. The next year he was engaged in working out the now familiar Mordey alternator, which, together with his transformer, has been widely used by the Brush company in England. It was a new departure in the construction of alternating current machinery and has since been followed by a large number of imitators.

Mr. Mordey's researches on the running of alternators in parallel have contributed very considerably to our knowledge of the subject, and his more recent work on the management of alternating currents constitutes one of the most valuable contributions to the literature of the subject. In 1888 he was elected an associate member of the council of the Institution of Electrical Engineers, and in the last two or three years has often appeared as a contributor to the columns of the scientific journals. During the past summer he has been traveling considerably on the Continent, inspecting the Frankfort Exposition and keeping an eye on scientific work in general, and arrived in America last week for a brief stay, devoted, so far as time allows, to the examination of the American electric traction systems. Mr. Mordey is a type of the thoroughly successful practical electrician, and deserves all the more credit for it as he is one of the few men who are both self-educated and well educated.



MR. W. M. MORDEY.

Note on the Volume Force of Solids.

BY REGINALD A. FESSENDEN.

For some time I have been engaged in collecting data with a view to redetermining the physical properties of solid bodies, more especially conductivitly. The data collected were found to vary very much. The most reliable, such as those of Matthiesen on conductivity, or those of Fizeau on expansion, can hardly be correct within several per cent.; in other cases variations of 50 per cent. were not uncommon.

A large amount of matter having been collected, it was arranged, due value being given to the known reputation of the observer and the causes which were most likely to have influenced his work.

From the data so arranged, uniformities were at once discoverable, which were generally hidden in taking any single set of observations, and it was found possible to give simple formulæ by which the various properties of matter could be calculated, having given only the atomic weight, density, temperature and chemical valency.

For example, the tensile strength of pure metals may be expressed by the formula

Tenacity in grammes per

$$\text{mm.}^2 = \frac{550000}{\text{valency} \times \sqrt[4]{\frac{\text{atom. wt.}}{\text{density}}}}.$$

The first of the series of notes, called "Atomic Volume and Tensile Strength," containing the proof of the above equation, was sent to *Nature* about a month ago. Other notes on "Melting Points of Metals" and "Conductivity of Metals" will follow as completed.

In the last number of the *Phil. Mag.*, which reached here several weeks after the note to *Nature* had been mailed, there appears a paper by Mr. William Sutherland, in which the author shows that there is a connection between the temperature of a metal and its rigidity, given by the formula

$$\frac{n}{N} = 1 - \left(\frac{\Theta}{T}\right)^2$$

where n is the rigidity at the observed temperature Θ, N the rigidity at absolute zero, and T the melting point. The author does not try to show any connection between the rigidity of the metals as compared with each other, merely showing that in the same metal it varies according to the above equation.

Now, since rigidity and tensile strength are intimately connected, being caused by the same force, the determinations by Mr. Sutherland of the rigidity of metals should vary in the same way as the data for tensile strength given by me in *Nature*—*i. e.*, should be a function of a force varying inversely as the square of the atomic volumes.

Such we find to be the case, as the following table will show, column I. containing the atomic volumes (*i. e.*, atomic weights divided by density of the metals); column II. the values for tenacity by myself in *Nature*, and column III. those for rigidity given by Mr. Sutherland.

	I.	II.	III.
Iron	7	42	750
Copper	7.1	41	430
Zinc	9.2	(15.77×2) 31.4	350
Silver	10.2	29.60	280
Gold	10.2	28.46	270
Aluminium	10.4	(10×3) 30	250
Magnesium	14	..	150
Tin	16	(3.40×4) 13.6	135
Lead	18	(2.36×4) 9.4	84

It will be seen that both tenacity and rigidity decrease regularly as the atomic volume increases; the former varying inversely as the $\frac{4}{3}$ power, the latter inversely as the square.

The reason for using the $\frac{4}{3}$ power is, that if wires of different metals of the same thickness be taken they will not have their atoms arranged the same, for the one with the larger atoms will have fewer in the cross section and their centres will be farther apart. All the results I have obtained, as to tenacity, melting point and conductivity, can be explained by supposing that there is a force acting between the particles of a solid which varies inversely as the square of the distance between the centres of the atoms.

If a metal have a larger atomic volume, the centres of two contiguous atoms will be farther apart and their attractive force less than if they had been smaller. It will consequently be weaker mechanically, and if all the elements have the same kinetic energy at the same temperature, then, all other things being the same, it will have a lower melting point. Thus iron, platinum and nickel have high melting points, and sodium, lead and tin melt at a low temperature.

The substitution of a single force varying inversely as the square of the diameters of the atoms and inversely as the square of the distance from their centres is such a simplification over that of supposing several forces varying as the fifth and sixth power of the distance, that it is to be hoped that it will be found to be true. So far all the evidence obtained is in favor of it, and in no case has it proved unable to explain the physical properties of matter; in fact, they all seem to be merely simple examples in dynamics where we have given us the size of the atoms, their weight, approximate velocity, kinetic energy, and the force holding the atoms together, which we may call the "volume force."

This force cannot be gravity. It is much greater than gravity, it varies as the volume and not as the weight of the atom, and does not extend beyond the immediate circle of surrounding atoms. It might perhaps be a force varying in any way, but with the number of times which it came into effect varying as the square of the volume.

But the simplest way of explaining it is this: Imagine a number of soap bubbles all of the same size, and charged with the same quantity of electricity at the same potential, then make them shrink in different degrees. Work will be done in shrinking them, and so the potential will rise, and if we suppose an atom like copper to have shrunk very much its voltage will be much greater than one like sodium, which has shrunk much less. We may suppose the charge on the metals and metaloids to be of different signs. This supposition can be extended to explain a great many other things, for if we suppose the sixty-six space nets of crystallography replaced by sixty-six dynamically stable ways in which the hydrogen atom may be arranged, we may suppose that one of each of these positions corresponds to one of the known stable elements. Carbon, for instance, may be represented in the following way as consisting of 12 hydrogen atoms, three on each corner of a tetrated iron.

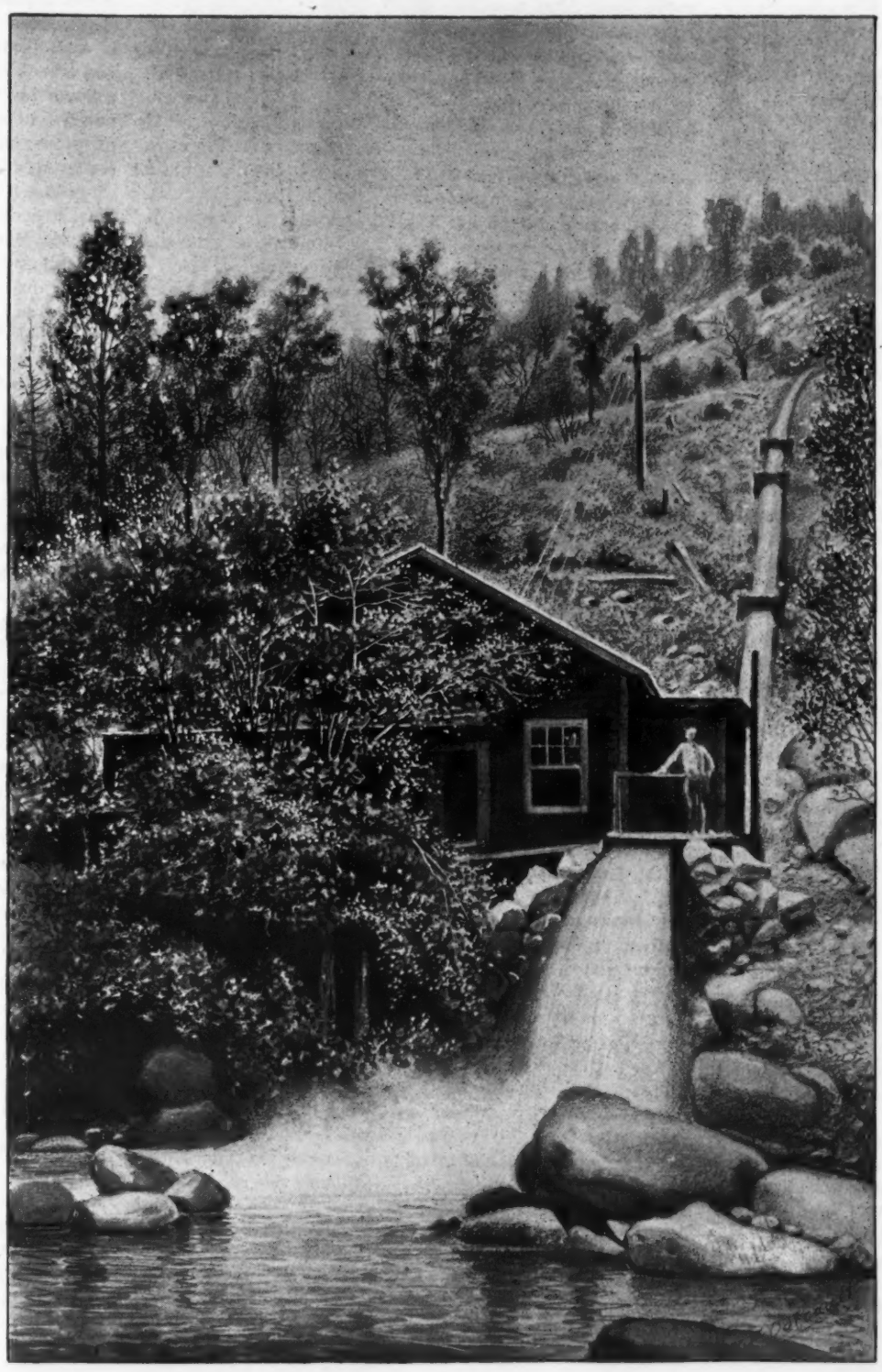
The electrical charges will be unevenly distributed, and thus we may suppose that chemical phenomena are merely examples of electrostatical attraction of different shaped bodies.

An application of this to the electrolytic theory of disassociation is of interest. It may be shown to follow from the assumptions made, that the disassociated ions in a solution have no charges, and therefore are not chemically active. Having no charges, their kinetic energy simply drives them apart, as there is no volume force (possibly identical with the cohesive force of gases of Van der Waals) to hold them together. There is thus no absorption of heat. Of course energy has been spent, but this has been done in the taking of the charge from the dissolved substance by the solvent; the result being that the freezing point of the solution is lowered more than normally, *i. e.*, more than by the solution of a non-ionizing salt. Moreover, the passing of a charge from the high potential salt to the low potential solvent must evolve heat, and the same amount in all cases per atom. Many other interesting points seem to be explained by the same theory, which even gives us a hint as to the nature of gravity.

NEW YORK CITY, July 25, 1891.

A California Mining Plant.

The Dalmatia mine and mills are situated far up in the California mountains distant from Placerville, the nearest railway station, about 15 miles, and nearly 60 miles northeast of Sacramento. The mining camp of Kelsey, where the Dalmatia mine is located, is 1,500 feet above the sea. Fuel is dear and the question of obtaining power for operating the mills is a serious one. The mine is owned by an English syndicate, and is under the management of Mr. G. C. Pearson. After considerable deliberation it was decided to install an electrical power plant. The nearest water is Rock Creek, a stream running down from the mountains into the western fork of the American River. The creek was tapped about two miles above the point where it empties into the river, and the water was then led through ditches dug and blasted along through the rocky soil until a point was reached about 100 feet above the river and 200 feet away from it; at the junction close down by the river bank was placed the power station, and the water is led into it through an iron pipe 28 inches in diameter running down the hillside. At the power house is installed a large Pelton water wheel that drives a jack shaft to which is belted a Brush compound wound generator giving 1,800 volts and 40 ampères. The current from this is led through a circuit of No. 3 copper wire over the mountains to the mills one and a half miles distant from the power house. The complete circuit is therefore a little more than three miles in length. Here the motor equipment is situated and drives the stamps, settlers and other mining machinery. Our cut gives a view of the power house and the long pipe leading down from the hills. The plant was installed by Mr. H. S. Connor, the well-known electrician of the Brush Electric Company, and from the very start has given excellent satisfaction. Mr. Pearson, the manager of the mine, is so thoroughly pleased with the installation that he is now considering the possibilities of the American River as a source of future power. It is a considerable stream and an enormous amount of energy is running to waste that might well be utilized in mining operations throughout the surrounding country. Altogether the Dalmatia plant is a capital specimen of the economical and effective way in which electric power can be utilized.



POWER PLANT OF THE DALMATIA MINE AT KELSEY, CAL.

Notes on Permanent Magnets.—II.*

BY PROF. SILVANUS P. THOMPSON, F. R. S.

There are several ways of hardening steel. One is by suddenly cooling it from a bright red heat; another is by subjecting it to enormous pressure by hydraulic machinery while it slowly cools down. In the former method, which is the usual one, the outer crust cools suddenly, while the inner portion is still plastic, and probably compresses it by natural contraction. In the latter method the hardening, though less extreme, is more uniform throughout. It is also possible to harden wires by mere longitudinal traction, as is well known. But this is not used in the manufacture of magnets. If thin rods of steel are heated to a brilliant redness, or even almost to whiteness, and then suddenly plunged into water, oil, or, best of all, mercury, they become intensely hard and brittle, and, indeed, are frequently split in the process. This state is known as *glass-hard*. If the glass-hard steel is then reheated to near a very dull red heat, for a short time, it softens somewhat, and acquires a pale yellowish tint on the surface, this temper being technically known as *straw color*. If it is still further let down by continuing the reheating it becomes *blue* in tint, this temper being used for steel springs, steel pens and other purposes requiring flexibility. If the reheating is carried still further the steel becomes soft, being annealed by the continued exposure to a dull red heat. Now, if it were true that the hardest magnets were the best, it is clear that none ought to be tempered down, but all should be left glass-hard, which is not found in practice to be by any means the best course.

Galvanic Estimation of Hardness.—The specification of the degree of hardness by tint is extremely vague. Happily it has been found that steel possesses another and more measurable quality which exists in almost exact proportion to the hardness of the specimen—namely, its electric resistance. Barus,† who examined this fact, and Fromme,‡ have shown that this relation is very close; and Strouhal and Barus* have used this property to specify the hardness of various bars subjected to magnetization. As an example they give the following values for a sample of steel:

State.	Specific resistance in microhms per centimetre cube.
Glass-hard	45.7
Bright straw tint	28.9
Straw tint	26.3
Blue tint	20.5
Bright blue tint	18.4
Soft	15.9

Influence of Form on the Temper that will give a Maximum of Permanent Magnetism.—In all comparisons between hardness and retentiveness, account must be taken of the form of the magnet, for, as already mentioned, short magnets and long magnets possess different properties. In almost all the experiments made on this matter, the steel rods or wires used have been of square or circular section, usually the latter. Consequently, the most convenient way of describing the form of a straight magnet is to state how many times its length is greater than its diameter. In some of Ewing's experiments on soft iron, rods were used varying in length from 50 to 200 diameters, and the results showed that even though the temporary magnetization was forced up to about the same degree for all, yet the longer rods showed a greater remanence than the short ones. It will be convenient to use the symbol δ for the ratio of length to diameter.

Some important researches were made by Cheesman,† on the effect of hardening by stretching on magnets of different dimensions. Using an English "silver steel" wire (of Messrs. Cook), 1.28 millimetres in diameter and 90 millimetres long (*i. e.*, $\delta = 70$), magnetized by contact with a large electromagnet, he found the result of hardening by stretching to *decrease* the amount of permanent magnetism which the magnet would receive. The magnetizing was repeated after each stretching.

	Stretching weight in kilogrammes.	Specific magnetization.
Steel, soft	0	78.1
Harder	30	77.3
Still harder	60	70.8
Still harder	70	63.7
(Wire broke)	75	55.6

In another series of experiments the length was varied.

Dimension-ratio. δ	Specific magnetization.	
	Soft.	Hard.
22.5	16.4	18.0
40 4	48.0	48.4
58.6	75 6	60.4

From these and numerous other experiments Cheesman concluded that for short magnets hardening the steel increased the retentiveness, while for long magnets hardening decreased it. He fixed upon 41 diameters as the critical value of δ for this kind of steel.

Messrs. Strouhal and Barus made a much more searching investigation of the matter, including the question of tempering. They used various sorts of iron and steel; but the results now quoted relate to magnets made of "silver-steel" wire, of Messrs. Cook, of Sheffield, of diameter 1.48 millimetres, and density 7.7. Of this steel five magnets were prepared, varying from 10 diameters to 50 in length. These were first made glass-hard by sudden cooling in water and then magnetized. They were then subjected to the following processes, their magnetism, after being remagnetized in a coil supplied with current of 80 ampères, from a dynamo machine, being observed (by a magnetometer) from time to time: Heated (*a*) in steam at 100 degrees C. for one hour, two, three, four hours; (*b*) in anilin vapor at 185 degrees for 20 minutes, one hour, two, four, six hours; (*c*) in melting tin at 240 degrees; (*d*) in melting lead at 330 degrees; (*e*) in melting zinc at 420 degrees (this latter temperature is a dull red heat); (*f*) to red heat so as to reduce the steel to complete softness, the magnet being laid in lime in a piece of gas tubing, and thereafter slowly cooled down. The results, which are of the highest importance, are given in table I.

This table is but one of a large number, all tending to the same general result. The figures given under the column of "Hardness" are the specific electric resistances in microhms. It is interesting to observe how with short magnets the specific magnetization decreases, then shows a tendency to increase, then decreases again, as the softening proceeds. Another point is that in every case heating in steam slightly reduces the magnetization that a magnet will retain; but that after some five or six hours a practically constant value is attained.

A very large number of observations with wire of the the same sorts was made by these experimenters, with practically identical results. They endeavored to fix (on the galvanic scale) the actual hardness and magnetic value of their steel when tempered to the tints recognized by workmen, with the results shown in table II.

These results agree with those obtained by Ruths,* who found (using another sort of steel) that for short magnets ($\delta = 20$), the specific magnetism fell from glass-hard, 51, to 28.4 when tempered blue, while for long magnets ($\delta = 70$) the specific magnetization, which was 68.7 for the glass-hard state, increased to 92 when tempered blue.

TABLE I.

Course of tempering.	Hardness.	Specific magnetizations.				
$\delta =$		9.9	20.3	29.2	40.5	49.8
Glass-hard	43.8	....	24.8	41.0	47.2	50.8	52.5
1 hour in steam at 100°	38.6	....	23.3	39.2	45.2	48.7	50.4
3 hours " "	36.5	....	23.4	38 6	44.5	47.7	49.3
6 " " "	35.1	....	23.3	38.6	44.3	47.4	49.1
10 " " "	34.3	....	23.3	38.3	44.2	47.4	48.9
20 min. in anilin vapor at 185°	29.0	....	21.0	38.9	46 0	50.3	52 3
1 hour " "	27.5	....	21.3	40 2	48.1	52.9	55.1
3 hours " "	25.6	....	21.6	42.7	52.2	57.7	60.2
7 " " "	24.2	....	21 8	45.5	56 9	63.5	66.8
13 " " "	22.9	....	20.9	46.2	59.7	68.1	71.8
10 min. in molten tin at 240°	22.2	....	20.4	46 7	61.0	70.2	74.3
1 " " lead at 330°	19.0	....	19.0	46.7	68.0	83.7	9.00
1 hour " zinc " 420°	16.2	....	14.4	40.1	72 6	93.9	103.9
Annealed	14.9	....	4.3	10.2	18.7	29.8	42.4

* Continued from THE ELECTRICAL WORLD, Aug. 1, 1891.
† *Wied. Ann.*, vol. VII., 1879, p. 411.
‡ *Ib.*, vol. VIII., 1879, p. 352.

* *Wied. Ann.*, vol. XX., 1883, p. 525.
†Cheesman: *Ueber den Einfluss der mechanischen Harte auf die magnetischen Eigenschaften des Stahles und des Eisens.* Inaug-diss., 1882, Leipzig. See also *Weid. Ann.*, XV., 204, and XVI., 712 (1882).

* Ruths. *Ueber den Magnetismus weicher Eisencylinder und Verschiedener harter Stahlsorten.* Dortmund, 1876.

Fixidity of Magnetism.—The researches summarized above, important as they are, do not, however, answer the question, What state of temper produces a magnetization of the greatest constancy in amount? This precious quality, to which Scoresby* gave the name "fixidity," cannot even be predetermined by an inspection of the values of the coercive force, such as have been given by Hopkinson, because these are themselves subject to change with time. Scoresby suggested a method of examining the change of magnetism

Table II.

State of temper.	Hardness.	Mean specific magnetization.					
		$\delta =$	10	20	30	40	50
Glass-hard..	45.7	.....	23.5	37.6	43 6	46.5	48.3
Straw tint..	26.3	.....	21.4	40.2	49.4	53.8	56.5
Blue tint....	20.5	.....	19.3	45.8	67.0	80.4	87.3
An'eal'd soft	15.9	.....	4.3	11.2	20.5	31.8	44.6

which was brought about by placing the magnet gently down upon the similar poles of another and more powerful one. He took as a measure of the goodness of a magnet (for the purpose of compass needles, etc.) the product of its original strength into its reduced strength after such treatment. By this method Scoresby (whose magnets were 6 inches long, 0.5 inch broad, and from 0.5 to 0.0625 inch thick) found the percentage of reduction to be least in cast steel when hard, and to be less when tempered blue throughout than when tempered at the extremities only. Kater † found that for compass needles of *thin* steel it was of advantage to temper down soft the middles of the needles, having the ends only hard.

A Course of Electrical Reading.

BY DR. LOUIS BELL.

"Won't you please recommend some good books for one who wants to take up the study of electricity?" is a question that is asked of the writer so frequently that it has seemed worth while to put the answer on paper in a somewhat extended form. Now, just at the present time it is by no means an easy matter to suggest electrical books appropriate for beginners, for the very good reason that in this year of grace, 1891, there are few elementary treatises on electricity that are thoroughly satisfactory, and the science of electricity, to say nothing of its application, is changing and growing with immense rapidity. In saying that the science of electricity is changing rapidly I do not at all intend to imply that the well-known principles of electricity that have led to such important results are being modified in any serious way, nor that the equations of electrical action which the mathematicians have been accustomed to use are in any sense invalidated; the difference is one rather of interpretation than of principles. About the safest course for one taking up the study of electrical science is to familiarize himself with the phenomena, facts and laws of electrical action as they may be found well laid down in various treatises that are within reach, and then to study the interpretation of them in the light of recent investigation, and make himself familiar so far as possible with the applications that are so numerous. Perhaps the work that one should mention first in suggesting a course of electrical reading is S. P. Thompson's "Elementary Treatise on Electricity and Magnetism." The last edition, that of 1891, was revised by its author in the beginning of 1889, and consequently includes some of the more recent results of research, particularly those of Hertz and Lodge that have since developed in a very important way. The book will not be found to be exceedingly simple, nor to constitute a smooth and easy path to electrical science; but it is an admirable compendium of the elements of our present knowledge. There is to-day no book of a more elementary character that is likely to have a permanent value to the student or is able to give a beginner a better start. Another excellent work of about the same order of simplicity is Jenkin's "Electricity and Magnetism," which may very well be used in connection with the little treatise just mentioned. A third book that is very attractive to those who have a keen interest in the applications of electricity is Dr. J. A. Fleming's "Short Lectures to Electrical Artisans." This is by no means as complete as the books just mentioned, but appeals somewhat more to the practical reader, and is thoroughly sound in its discussion of the topics taken up. No complicated mathematics are involved in any of the books mentioned, but a somewhat elementary knowledge of algebra is necessary for their intelligent comprehension. Careful study of the trio of volumes will give a firm foundation on which to build an electrical education. In connection with these I will name three books of a very popular character that will prove serviceable, not so much as a means of instruction in electricity as by furnishing in an interesting form a vast deal of information about what we can do with electricity in the way of practical applications. These three are the following: "Electricity in Modern Life," by De Tunzelmann; "Electricity in Daily Life," a volume of collected papers, by various authors; and finally a little volume, "Electricity and Its Recent Applications," by Trevert. These are decidedly interesting reading, comparatively simple, and intended for popular edification, rather than for grounding the student in the principles of modern electricity. The last mentioned is useful principally in giving a general idea of electrical apparatus, what it looks like, and how it works. In addition to these I will suggest Houston's electrical dictionary, which contains a very large amount of valuable information, and can be relied upon to furnish explanations of a good many things that one meets in reading electrical books.

Up to this point the student will not require for his reading any more mathematics than is absolutely necessary if he is going on to become anything more than a "hack" electrician, working by rule of thumb and trusting to fortune to get him out of any difficulties he may chance to meet. I cannot too strongly urge on any student of electricity the necessity of doing laboratory work. Fortunately electrical laboratories are not difficult to find at this day, and much can be done with very simple apparatus, even where an extensive equipment is not at hand. There are three admirable books that may be recommended to the laboratory student as suitable guides to his work. The first and the simplest of them is Stewart & Gee's "Practical Physics for Schools," a very clear and simple little book, full of instructive experiments. To it may be added the second volume of Stewart & Gee's "Elementary Practical Physics," that treating of electricity and magnetism. This is a standard work in laboratory instruction and by no means to be despised as a book of reference long after the student has passed the elementary stages of his work. The third handbook is Prof. Ayrton's "Practical Electricity," an excellent treatise in every way. Now at this point in the course of electrical reading there may be pursued two radically different lines. In the first place one may trust to what he has already acquired, for theoretical knowledge, and go on reading with a view of securing practical information, leaving to others who have more time and opportunity the further pursuit of the higher branches of the science. In the second place one may use the information that he has obtained as the basis for a considerably more extensive course that will lead up to all the modern developments of theory and refinements of practice. If he chooses to pursue the latter course it is absolutely necessary that he should acquire a certain amount of mathematics, for without them he will be totally unable to read intelligently the standard treatises on electricity, or to understand the research work that the great investigators are doing to-day. For this purpose the more practical mathematics studied the better, but generally very little can be done here in self-instruction. For those who already have the knowledge or can acquire it a wide field is opened. As a beginning in following up electrical theory two small volumes may be kindly spoken of; one of them is a companion to S. P. Thompson's elementary lessons above referred to, and is entitled "Notes on Electricity and Magnetism," from the pen of Lieut. Murdock. The other is Cumming's "Introduction to the Theory of Electricity." The methods employed in the two are somewhat different. Murdock's book involves the elements of calculus and its application to electrical problems; Cumming deals principally with algebraic and geometric proofs, and gives the elementary theory of electricity fairly well. After pursuing the study of these preparatory treatises the next book that may profitably be taken up is Mascart & Joubert's "Electricity and Magnetism." This consists of two volumes, the first dealing with the theory, the second with its applications, and forms on the whole a very satisfactory treatment of the subject. The work is a translation from the French, and will furnish solid reading for a considerable time. After this one cannot do better than to take up, if he desires to follow the subject still further, the great treatise of Maxwell on "Electricity and Magnetism." It is difficult reading compared with Mascart & Joubert, but it is the work of a master hand and is the book to which every one who is at all familiar with it instinctively turns for reference when cornered by any difficulty in electrical theory; furthermore, a very large number of things not treated in detail are hinted at so broadly that their meaning cannot be mistaken in the light of recent investigations, and still others are treated in a manner almost prophetic as viewed from the standpoint of to-day. For example, the modern theory of the magnetic circuit is there stated in terms so plain that one is filled with wonder at the years that passed before the work was further developed; and the marvelous relations between electricity and light are made so evident that one is not surprised at the confirmation they have received from the beautiful researches of Hertz and others within the last three years.

Along with these more elaborate treatises one may, with great profit, spend no small amount of time in the careful study of Faraday's "Experimental Researches in Electricity," the magnificent monument of a great man's life work. Not only was Faraday the discoverer of innumerable facts, but his grasp of theory was so profound that much of Maxwell's work is the mathematical development of Faraday's wonderfully keen suggestions. As an introduction to modern researches the student might well pick up at this point Lodge's little book on "Modern Views of Electricity." It is a work not to be recommended to the elementary student, because for its proper comprehension a good groundwork of electrical theory is necessary, and, furthermore, because its daring method of treatment is very likely to lead the beginner widely astray, unguided as he is by any thorough knowledge of electrical theories and principles. As regards the extremely important work of the past three years, nothing in the way of a complete volume exists; whoever desires to pursue the subject to its uttermost limits must depend on the current electrical literature as found in the periodicals, the American and English electrical journals, the *Philosophical Magazine* and the transactions of the various learned societies abroad.

For the reader who does not care to pursue elaborately the study of electrical theory, but who desires to pass at once to more practical topics, it is by no means easy to suggest the appropriate course of reading. One book that may properly be mentioned, however, is Slingo & Brooker's "Electrical Engineering," perhaps the best elementary manual of the subject, and which contains a vast deal that will be of value, and is to a certain extent used as a text book of the subject. Another book worth reading, albeit it is of a somewhat heterogeneous character, is the treatise on "Practical Electrical Engineering" now being published in parts and written by an aggregation of well-known electricians. Fiske's "Electricity in Theory and Practice" is another available manual for the practical electrician, and a book almost indispensable is Prof. S. P. Thompson's treatise on "Dynamo-Electric Machinery." This unfortunately is now out of print, but a new edition is now in course of preparation and will eventually appear. Occasionally copies may be picked up in second-hand book stores, but otherwise it will be very difficult to obtain it until the new edition comes out. Carl Hering's treatise on "Dynamo-Electric Machines" is a somewhat simpler treatment of the same subject and has the advantage of being much more readily obtained. Both these works deal especially with the dynamo, its theory and construction. With them may be placed Kapp's "Electric Transmission of Energy," which stands in the same relation to the motor that the above mentioned books do to the dynamo proper. Martin & Wetzler's "The Electric Motor," of which a new edition is now in press, may also be suggested as an available book for general instruction in the progress that has been made rather than in the theory of the subject. Of practical hand books for the working electrical engineer the number is small. Perhaps the best known and most generally useful is Munroe & Jamieson's "Electricians' Pocket Book," which stands much in the same relation to electrical engineering as do the well-known treatises of Haswell and Trautwine to civil engineering. It is of convenient shape for the pocket and is full of condensed information.

This group of practical books just mentioned is thoroughly serviceable to the electrician who is deeply versed in theory as well as to those who have a less profound knowledge of the subject. Up to the present we have been dealing with books on electrical topics in general, passing by, temporarily, those intended for careful discussion of special departments of applied electricity. The number of these is now considerable, covering almost all topics in which the electrical engineer is likely to be interested, and here at last the theoretical student and the work-a-day electrician have to meet on a common literary ground, as the treatises are for the most part of a rather practical character. The former class will have greatly the advantage in reading certain of these, however, and the more knowledge that has been acquired in previous stages of electrical studies, the more completely will these special treatises be comprehended, and the more readily the information derived from them will be applied. There is no royal road to electrical knowledge, and he who seeks it is bound for continued and exasperating disappointments. The natural tendency is to begin reading special works before the general ones have been thoroughly mastered, and the result of this, too often, is a half-baked sort of electrician, neither capable of avoiding difficulties nor, what is more important, of extricating himself if he has the misfortune to run afoul of them. Dropping then, for the time being, the general works that treat of electrical theory and practice, one may pass to the classification of special treatises and their application to the needs of various classes of electrical students and workers.

(*To be continued.*)

*Scoresby. *Magnetical Investigations*, vol. I., p. 35.
†Bakerian Lecture (*Phil. Trans.*), 1821.

The Electrical Census of the State of New York.

Hon. Robert H. Porter has, upon the recommendation of Mr. Allen R. Foote, appointed Mr. Horatio A. Foster, of this city, special agent for the collection of statistics relating to the electrical industries for the State of New York. In making the appointment it is the intention of the Census Office to complete the work for the State of New York and to publish the results in a special bulletin at the earliest practicable date. It will therefore be the good fortune of this State not only to have the benefit of the publication in advance of all other States, but also the honor of being first in the series of bulletins to give the results of the Electrical Census of the United States. For these reasons the Census Office and all interested in this department of its work are extremely anxious to have the report for New York complete and accurate in every detail. It is especially desirable that every person in the State in any way interested in the electrical industries shall cordially co-operate with Mr. Foster in facilitating his work and furthering the general interests involved.

Mr. Foster will visit every central station, electric railroad and the more important isolated plants in the state and assist their superintendents in correctly filling the official

schedule. All schedules that have been sent to Washington are put into his hands for correction and verification.

A very great service will be rendered by each superintendent if he will earnestly endeavor to assist in completing the work, so far as his station is concerned, in the shortest possible time consistent with accuracy. To assist in saving time it is suggested that each superintendent should have a correct memorandum for Mr. Foster, covering the following details:

1. Average number of poles per mile.
2. Kind of wood.
3. Number of poles, part wood and part iron.
4. Total length of conductors on poles.
5. Total length of conductors on housetops.
6. Total length of conductors on bridges.
7. Total number of service connections.
8. Number of service connections on each alternating current main.
9. Total cost of all aerial conductors.
10. Total annual cost of maintaining all aerial conductors.

Mr. Foster will give each company due notice of the date when he will call for the purpose of finishing up its schedule and will give all the assistance that may be necessary.

It is the opinion, without exception, of all who know Mr. Foster personally, and of those who have read his recent articles on "Central Station Management and Finance," that no other person is as well fitted as he is, in all particulars, for the work he is to undertake.

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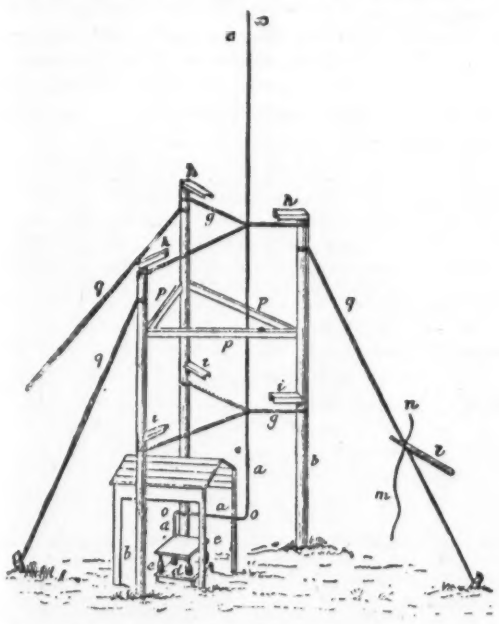
Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1750.——Michell (John), an eminent English man of science, professor at Queen's College, Cambridge, publishes "A treatise of Artificial Magnets, in which is shown an easy and expeditious method of making them superior to the best natural ones."

The process introduced by this work is known as that of the "double touch." This consists in first joining together, at the distance of about a quarter of an inch, two bundles of strongly magnetized bars, having their opposite poles together, and in drawing them backward and forward upon and throughout the entire length of the bars to be magnetized, which latter have previously been laid down end to end and in a straight line. The operation is to be repeated upon each side of the bars. It is found that the central bars of a series acquire at first a higher degree of magnetism than do the outer ones, but by transposing the latter and treating all alike the magnetic virtue is equally distributed. In this process the external bars act the same part as do the pieces of soft iron employed by the Du Hamel method.

At chapter VI., p. 20, of the third volume of his "Rudimentary Magnetism," Harris thus expresses himself: "Mich-



FIRST LIGHTNING ROD PROPOSED BY FRANKLIN.

ell advanced the idea that in all the experiments of Hauksbee, Dr. Brooke Taylor, William Whiston and Musschenbroeck, the force may really be in the inverse duplicate ratio of the distances, proper allowance being made for the disturbing changes in the magnetic forces so inseparable from the nature of the experiment. He is hence led to conclude that the true law of the force is identical with that of gravity, although he does not set it down as certain."

See Harris, "Rud. Mag.," I. and II., pp. 94–95; C. R. Weld, "Hist. Roy. Soc.," Vol. I., p. 512; Gaugain's observations in "Sc. Am. Suppl," No. 7, page 99.

A. D. 1750.——Boulanger—not Boullangère—(Nicholas Antoine), a well-known French writer, whose extensive studies were interrupted by his death, in 1759, at the early age of thirty-seven, gives, in his "Traité de la cause et des phénomènes de l'électricité," accounts of many important observations made in the electrical field.

*Continued from THE ELECTRICAL WORLD, Aug. 1, 1891.

His attention was carefully given to ascertaining the degrees in which different substances are capable of being excited, and he gives several lists of such, inferring therefrom that the most transparent and the most brittle are always the most electric.

At pages 64 and 124 of the above-named "Traité" he states that mineral waters are much more sensibly affected by electricity than is common water; that black ribbons are more readily attracted than those of other colors, next to the black being the brown and deep red; and that, of two glass cylinders exactly alike, except that one is transparent and the other slightly colored, the transparent one will be the more readily excited.

BENJAMIN FRANKLIN.

See also the "Traité," notably at pages 135 and 164.

A. D. 1751.——Adanson (Michael), a French naturalist of very high reputation, who, before the age of nineteen, had actually described four thousand species of the three kingdoms of nature, introduces, in his "History of Senegal" the *silurus electricus*, a large species of eel originally brought from Surinam. Sir John Leslie states that the *silurus* is furnished with a very peculiar and complex nervous apparatus which has been fancifully likened to an electrical battery, and that, from a healthy specimen exhibited in London, vivid sparks were drawn in a darkened room. Mr. Broussonet alludes to the *silurus* as *Le Trembleur* in the "Hist. de l' Acad. Royale des Sciences" for 1782, page 692.

Adanson also called attention, in 1756, to the electrical powers of the *malapterus electricus*, but, according to the able naturalist, James Wilson ("Ichthyology," *Enc. Brit.*), there is a much earlier account of the fish extracted from the narrative of Baretus and Oviedo dated 1554.

The Swedish naturalist, Karl A. Rudolphi, pupil of Linnæus, called the *princeps helminthologorum*, has given a detailed description as well as illustrations of the electric organs of the *malapterus* in "Ueber den Zitterwels," *Abh. Berl. Acad.* VII. . . . This fish, which the Arabs call *Raad* or *Raash* (thunder), gives its discharge when touched on the head, but is powerless when held by the tail, the electrical organs in fact not reaching the caudal fin.

To Adanson has been attributed the authorship of an essay on the "Electricity of the Tourmaline," Paris, 1757, which bears the name of the Duke de Noya Caraffa.

See: Spreng. "Hist. of Herb.," vol. II.; and Adanson's Biog., vol. II., "Enc. Britannica," Rees' "Cycl." Supplement and in "Bibl. Universelle," vol. I.; Chambers' "Ency." for 1868, vol. III., p. 822; Cavallo, "Nat. Phils," Philad., 1825, vol. II., p. 237; *Scientific American Supplement*, No. 457, pp. 7,300, 7,301; Rozier, vol. XXVII., p. 139.

A. D. 1752.——Franklin (Benjamin), an able American editor, philosopher and statesman, crowns his many active, patient and intelligent experiments with the brilliant discovery of the identity of electricity and lightning. De Humboldt says: "From this period the electric process passes from the domain of speculative physics into that of cosmical contemplation—from the recesses of the study to the freedom of nature." ("Cosmos," vol. II., 1849, p. 727.)

Wall (A. D. 1708) had merely alluded to the resemblance of electricity to thunder and lightning, Grey (A. D. 1720) had conjectured their identity and implied that they differed only in one degree, while Nollet (A. D. 1746) pointed out a closer relationship than ever before adduced between lightning and the electric spark; but it was left for Franklin to prove the fact with empirical certainty.

Franklin's attention was first directed to electrical studies in 1745, by a letter from Peter Collinson, fellow of the Royal Society of London, to the Literary Society of Philadelphia, and he first wrote on the subject to that gentleman on the 28th of July, 1747. This was followed by several other similar communications up to April 18, 1754, the whole of which comprise most of what subsequently appeared under the title "New Experiments and Observations on Electricity, made at Philadelphia, in America, by Benjamin Franklin, LL. D. and F. R. S."

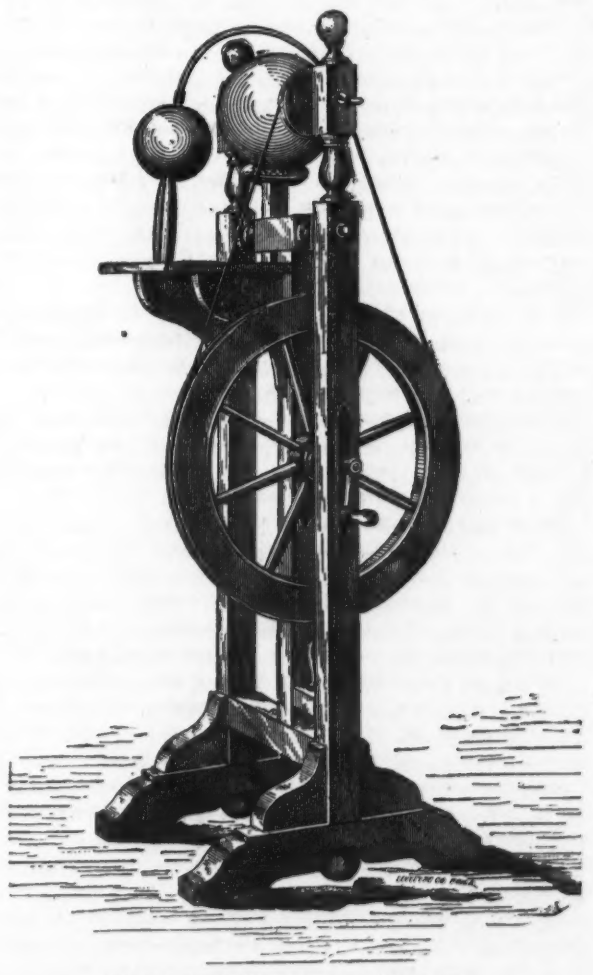
Franklin first entertained the idea that lightning was not likely to be attracted by a pointed rod unless the latter was placed at a great height, and he therefore waited for the erection of a tall spire in Philadelphia which he intended to utilize for his observations, but delay in its completion led him to employ a kite pointed with an iron rod, not doubting that the electric fluid could, during a thunder storm, be drawn from it through a string. He made a kite of two crossed strips of cedar, upon which he spread a large silken handkerchief, and to the lower extremity of the iron-pointed rod he attached a hempen cord the end of which was tied to a key. To the latter he fastened a strip of silk ribbon, in order that the electricity in its descent should not reach the holder of the cord.

During the month of June, 1752, on the approach of a storm, he and his son walked out upon the Philadelphia Commons and raised the kite. At first no important results were obtained, but as soon as the cord became wet by the shower that followed, the electric sparks were easily drawn from the key and enabled Franklin to charge and give shocks from a Leyden jar.

After alluding to this experiment, Franklin thus expresses himself in a letter, under date Oct. 19, 1752, taken from the quarto volume published in London, 1774. " . . . At this key the phial (Leyden jar) may be charged; and, from the electric fire thus obtained, spirits may be kindled, and all the other electric experiments be formed which are usually done by the help of a rubbed glass globe or tube, and thereby the sameness of the electric matter with that of lightning completely demonstrated."

Thus, says Sabine, was Benjamin Franklin successful in one of the boldest experiments ever made by man upon the powers of nature, and from that moment he became immortal.

He had already, in 1749, made public the following, which is embodied in one of his letters to Mr. Collinson: "The electrical spark is zigzag, and not straight; so is lightning. Pointed bodies attract electricity; lightning strikes mountains, trees, spires, masts and chimneys. When different paths are offered to the escape of electricity, it chooses the best conductor; so does lightning. Electricity fires combustibles; so does lightning. Electricity fuses metals; so does lightning. Lightning rends bad conductors when it strikes them; so does electricity when rendered sufficiently strong. Lightning reverses the poles of a magnet; electricity has the same effect." Franklin had, besides, published, about the same period the plan for an experiment to determine from elevated structures whether the clouds that contain lightning are electrified or not. This plan he himself proposed to put to execution; but he was led, as we have seen, to try the kite experiment, and, in the meantime, his suggestions had been successfully acted upon, in France, by Messrs. Dalibard and Delor, as will be shown in the following article.



FRANKLIN'S ELECTRICAL MACHINE.

"The lightning, which doth cease to be, ere one can say, 'it lightens.'"—*Shakespeare.*

"First let me talk with this philosopher; what is the cause of thunder?"—*Shakespeare.*

" . . . a way for the lightning of the thunder."—*Job*, xxviii., 26, and xxxviii., 25.

"It related not to the instances of the *magneticalness* of lightning."—*Hist. of Roy. Soc.*, vol. IV., p. 253.

When specifying the great points of coincidence existing between the ordinary electric discharge and lightning, Franklin, as already partly stated, had remarked that flashes of lightning are frequently waving and crooked, of a zigzag or forked appearance, sometimes diffused and sometimes colored ("On the Nature of Thunderstorms," W. Snow Harris, London, 1843, page 24; Priestley, "History and Present State of Electricity," London, 1769, page 166; "Encycl. Metropol.," article "Electricity"; Biot, "Traité de Physique," vol. II.) In treating of the subject of lightning flashes, Dr. L. D. Gale (Transl. of Mr. F. J. F. Duprez's paper on Atmospheric Electricity, taken from the memoirs of the Royal Academy of Brussels) alludes to the attempts made by C. G. Helvig to determine the velocity of the linear flashes (Gilbert's *Annalen*, vol. LI., pages 136 and 139, S. 2, S. 10), which he estimated to be 40,000 to 50,000 feet in a second, and states that Mr. Weigsenborn, of Weimar (*Comptes Rendus*, vol. IX., page 218), calculated the velocity of a flash observed in 1839 to be more than two leagues, while Mr. François Arago ("Annuaire, etc.," pour l'année 1838, pages 249, 255, 257, 459) estimated the lengths of certain flashes to be 3.3, 3.6, 3.8 leagues. The views of Messrs. Logan (*Phil. Trans.*, 1735, vol. XXXIX., page 240), L. J. Gay-Lussac (*Ann. de Chim. et de Phys.*, 1805, vol. XXIX., page 105), H. W. Brandes ("Beiträge zur Witterungskunde, etc.," 1820, page 353), C. H. Pfaff and L. E. Kaemtz (J. S. T. Gehler, "Dict. de Phys.," vol. I,, page 1,001, and "Lehrbuch d. Meteor," vol. II., page 430), Gabriel Lamé ("Cours. de Phys. de l'Ecole Polytech.," tome II., 2e partie, page 82), Becquerel (*Comptes Rendus*, 1839, tome VIII., page 216), Faraday (*Philos. Magazine*, 1841, vol. XIX., page 104), Pouillet ("Eléments de Phys. et de Météor," tome II., page 808), Parrot (J. S. T. Gehler, "Dict. de Phys.," vol. I., page 999), are also set forth in the above-named translation of Mr. Duprez's important work.

Humboldt informs us that "the most important ancient notice of the relations between lightning and conducting metals is that of Ctesias, in his *Indica*, cap. IV., page 169. He possessed two iron swords, presents from the King Artaxerxes Mnemon, and from his mother Parysatis, which, when planted in the earth, averted clouds, hail and *strokes of lightning*. He had, himself, seen the operation, for the king had twice made the experiment before his eyes" ("Cosmos," vol. II., N. 186). Ctesias was a man of great learning. He was a contemporary of Xenophon, and lived for a number of years at the Court of Artaxerxes Mnemon as private physician to the king. Diodorus states that Ctesias was highly honored at the Persian court. His *Indica*, to which Humboldt refers, is full of curious matter, and presents us with a picture of India such as it was conceived by the Persians. An abridged edition was printed by Stephens in 1594 ("Hist. Roy. Soc.," C. R. Weld, London, 1848, vol. II., page 93).

In imitation of Franklin, Doctor Lining, of Charleston, in South Carolina, sent a kite into a thunder cloud, and by that means dissipated the lightning (*Philosophical Transactions* for 1754, vol. XLVIII., page 757).

The opinion entertained by Franklin regarding the nature of electricity differs from that previously submitted by Dufay (A. D. 1733), in the manner shown by Noad, at page 6 of his Manual, London, 1859 edition.

What Dufay considered to be two distinct species of electricities, *vitreous* and *resinous*, Franklin conceived to be two different states of the same electricity, which he called respectively *positive* and *negative*. This, which constitutes the foundation of the present theory of electricity, is usually called the Franklinian theory. It belongs, however, equally to Dr. Watson, as he had communicated it to the Royal Society before Franklin's opinion on the subject reached England. (*Phil. Trans.* for 1748, vol. XLV., pp. 49, 491; Thompson, "Hist. Roy. Soc.," p. 436.) Noad, in paragraph 12, applies the latter theory to the case of a charged Leyden jar, alluding to Franklin's discovery of the location of electricity in the Leyden jar, wherefrom is drawn the conclusion that it is upon the glass that the electricity is deposited, and that the conducting coatings serve "only, like the armature of the loadstone, to unite the forces of the several parts and bring them at once to any point desired." (See "Œuvres de Franklin," trans. of Barbeu-Dubourg, tome II., p. 16, 3e lettre.)

Of his *plus* and *minus* theory, Franklin thus writes to Mr. Collinson: "To electrise *plus* or *minus*, no more needs to be known than this, that the parts of the tube or sphere that are rubbed do, in the instant of the friction, attract the electrical fire, and therefore take it from the thing rubbing, the same parts, immediately as the friction upon them ceases, are disposed to give the fire they have received to any body that has less."

In an appendix to his official report as U. S. Commissioner at the Paris Universal Exposition of 1867, entitled "Franklin and Electrical Semaphores," Professor Samuel F. B. Morse, LL. D., expresses himself as follows:

"It has frequently been asserted (on what authority I know not) that the first idea of an electric semaphore originated with Franklin. I have sought in vain in the publication of Franklin's experiments and works for anything confirmatory of this assertion. On mentioning the subject to my friend Professor Blake, he kindly proposed examining the writings of Franklin in order to elicit the truth. From him I have received the following:

"'I had consulted several works for the purpose of ascertaining, if possible, the foundation for the statement that Franklin suggested the idea of semaphores by static electricity. I have not yet found any such suggestion, but I have noted that, following the experiments by Dr. Watson and others, in England, to determine the *velocity* of the electric discharge, and the time supposed to be required for the electrical discharges across the Thames, by which spirits were kindled, etc. (in 1747), Dr. Franklin (in 1748) made some similar experiments upon the banks of the Schuylkill, and amused his friends by sending a spark "from side to side through the river without any other conductor than the water" (vide Priestley's "History of Electricity"). This was in 1748, at the end of the year. In 1756 "J. A., Esq.," of New York (James Alexander), presented to the Royal Society a proposition "to measure the time taken by an electric spark in moving through any given space" by sending the discharge or spark down the Susquehanna or Potomac, and around by way of the Mississippi and Ohio rivers, so that the "electric fire" would have a circuit of some thousands of miles to go. All this was upon the supposition or assumption that the electric fire would choose a continuous water conductor rather than to return or pass through the earth. Franklin presented a paper in reply, in which he says "the proposed experiment (though well imagined and very ingenious) of sending the spark round through a vast length of space, etc., etc., would not afford the satisfaction desired, though we could be sure that the motion of the electric fluid would be in that tract, and not underground in the wet earth by the shortest way."' ('Franklin's Experiments on Electricity, and Letters and Papers on Philosophical Subjects,' 4to, London, MDCCLXIX., pages 282, 283).

"Can it be possible that Franklin's experiment of firing spirits and showing the spark and the effects of the electric discharge across the river originated, or forms the foundation for, the statement that he suggested the semaphoric use of electricity?"

After speaking of the experiments upon the Schuylkill, to which allusion was made at A. D. 1745, Franklin writes: ". . . It is proposed to put an end to them for this season, somewhat humorously, in a party of pleasure. . . . Spirits at the same time are to be fired by a spark sent from side to side through the river without any other conductor than the water—an experiment which we some time since performed to the amazement of many. A turkey is to be killed for our dinner by the electrical shock, and roasted by the electrical jack, before a fire kindled by the electrified bottle, when the healths of all the famous electricians in England, Holland, France and Germany are to be drank in electrified bumpers under the discharge of guns from the electrical battery."

It was toward the close of the year 1750 that Franklin entertained the practicability of a lightning conductor (See Winckler, A. D. 1733), and, for this, he says, he was indebted to an experiment made by his friend Mr. Thomas Hopkinson (Vide Franklin's "Complete Works," London, 1806, vol. I., p. 172). In his "Poor Richard's Almanac," for 1753, he refers to the lightning rod as security for "habitations and other buildings from mischief by thunder and lightning."

See B. C. 600; J. B. Le Roy, "Lettera al Rozier, etc.," Milano, 1782; "Rec. de Mém. de l'Acad. des Sc." for 1770 and 1773; *Jour. de Phys.*, 1773, vol. II.; Memoirs of M. Beyer, Paris, 1806–1809, and Delaunay's explanation of his theories at pp. 193–198 of his 1809 Manual.

The many notable observations, experiments and discoveries of Franklin are nowhere more ably reviewed than by his great admirer Dr. Priestley, who devotes much space thereto in his justly celebrated work on electricity.

At page 92 of his "New Experiments, etc.," London, 1774, Franklin alludes to the failure of many European electricians in firing gunpowder by the electric spark, and gives his own method by using a battery of four large glass jars, while at page 423 of the London edition of his "Letters and Papers, etc.," Franklin relates curious observations which are worth mentioning here. He says that he sent a charge of electricity "through a small glass tube that had borne it well when empty, but when filled first with water was shattered to pieces and driven all about the room. Finding no part of the water on the table, I suspected it to have been reduced to vapor. I was confirmed in that suspicion afterward when I had filled a like piece of tube with ink and laid it on a sheet of paper, whereon after the explosion I could find neither any moisture nor any sully from the ink. This experiment of the explosion of water, which I believe was first made by that most ingenious electrician, Father Beccaxia, may account for what we sometimes see in a tree struck by lightning, when part of it is reduced to fine splinters like a broom; the sap vessels being so many tubes containing a watery fluid, which, when reduced to vapor, sends every tube lengthways. And, perhaps it is this rarefaction of the fluids in animal bodies killed by lightning or electricity, that by separating its fibres renders the flesh so tender and apt so much sooner to putrefy. I think, too, that much of the damage done by lightning to stone and brick walls may sometimes be owing to the explosion of water found during showers, running or lodging in the joints or small cavities or cracks that happen to be in the walls."

See Majus–May–(Heinrich) "Disp. de fulmine" and "Disp. de tonitru," Marp., 1673, as at Pogg. *Annalen*, vol. II., p. 21; Giuseppe Saverio Poli, "La formazione del Tuono, etc.," 1772, and his other works on the same subject which appeared during the years 1773, 1779 and 1787; *Phil. Trans.* for 1751, vol. XLVII., pp. 202, 289, 362; W. de Fouvielle, "Eclairs et Tonnerres"; *Jour. of the Franklin Institute* for 1836, vol. XVII., p. 183; M. le Docteur Sestier, "La Fondre"; "Lightning-Rod Conference," Reports of Delegates, by G. J. Symons, 1882; chap. III., sec. III., vol. I. of Van Swinden's "Recueil, etc.," 1784; *Lumière Electrique*, tome XL., No. 23, p. 497; J. B. Cardan's work, Lyons, 1633.

The Association of the Edison Illuminating Companies.

The regular annular convention of this association, as was stated some time ago in our columns, is to be held in this city, beginning Aug. 11. Arrangements have been made for the entertainment of the delegates at the Murray Hill Hotel, corner of Park avenue and Forty-first street. The programme as announced by Mr. W. J. Jenks, the secretary of the association, will be substantially as follows:

FIRST DAY, TUESDAY, AUG. 11, 10 A. M.

Opening address by the president, roll call, election of officers for the ensuing year.

Report of Executive Committee and action by the association regarding applications for membership.

Reports of secretary and treasurer.

AFTERNOON SESSION, 2 P. M.

Report of the Committee on the Prevention of Damage from Crosses of High Tension Circuits, by C. P. Gilbert, of Detroit, chairman.

Report of Committee on Lightning Protection, by A. E. Kennelly, of the Edison Laboratory, chairman, and the results of experiments at the laboratory on new forms of lightning arresters.

Report of Committee on Grounding the Neutral Wire in Three Wire Systems, by A. E. Kennelly, chairman.

Report of Committee on Fuel Gas, by J. R. Markle, of Detroit, chairman.

A visit to the office and stations of the Edison Electric Illuminating Company of New York, in response to an invitation of the company to inspect the special features of their three plants, and plans for the proposed comprehensive station near the City Hall.

SECOND DAY, AUG. 12, 10 A. M.

Address by officers of the Edison General Electric Company as to matters of commercial interest to the association and the patent litigation.

Paper—"How to Get a Paying Load for Stations," by William D. Marks, of Philadelphia.

Paper on the "Meters in Use in the Station of the Brooklyn Company," by R. S. White.

Paper—"How can Our Association best Serve Central Station Interests," by Frederic Nicholls, of Toronto.

AFTERNOON SESSION, 2 P. M.

Paper by W. L. Garrison, of the Brockton (Mass.) company. Subject to be announced.

Paper on "Important Details in Underground Conductors," by Mr. Stevenson, of the New York Illuminating Company.

Paper—"Some Practical Ideas on Distribution," by Leigh Carroll, of Birmingham, Ala.

Paper by C. L. Edgar, of Boston. Subject to be announced.

Paper—"Peculiar Features of the Edison Feeder System," by Wilson S. Howell.

"The Success of the Mutual Insurance Idea in Electric Light and Power Stations," by the secretary.

Paper by H. J. Smith, of the New York Illuminating Company. Subject to be announced.

Visit to the Edison Electric Illuminating Company, of Brooklyn, in response to an invitation by the officers of that company.

THIRD DAY.

Visit to the Schenectady works of the Edison General Electric Company. Delegates will leave the Grand Central Depot, New York, at 6 A. M. by special train with dining car attached, breakfast being served between New York and Albany. Arriving at Schenectady about 10 o'clock, the larger portion of the day will be spent in a detailed examination of the immense factories of the company, returning to New York in season to enable the delegates to attend the theatres or other amusements during the evening. Opportunity will also be given for a visit, by all members who may desire, to the lamp works of the general company at Harrison, N. J., the New York works, corner avenue B and Seventeenth street, and the Edison laboratory at Orange, N. J.

GENERAL FEATURES.

If necessary the exercises may be extended to embrace Friday, Aug. 14.

The courtesies of the New York Electric Club have been extended to all members of the association attending the convention, and privilege cards will be issued by the secretary to all individuals who may desire to avail themselves of the advantages thus afforded.

It will thus be seen that the programme of interesting features which will be provided for the delegates to this convention is one which has not been approached in interest by that arranged for any previous meeting. The Edison General Electric Company, the Edison Electric Illuminating Company of New York and the Edison Electric Illuminating Company of Brooklyn, all of which are, as is evident from the order of exercises, deeply interested in the success of this convention, extend all the privileges and courtesies in their power.

Balata.

An exhaustive report on balata, or chicle gum, has recently been drawn up by Mr. G. S. Jenman, government botanist and superintendent of the botanic gardens in British Guiana. The bullet-tree, from the bark of which balata is obtained, says *The Electrician* (London), is a large forest tree ranging from Jamaica and Trinidad to Venezuela and Guiana. The tree grows to a height of 120 feet, and has a large spreading head. The trunk is nearly cylindrical. The bark is about ½ inch thick, with deep parallel fissures an inch or so apart. The hard, reddish colored wood is one of the densest in the colony, and is used for all sorts of purposes where great strength and durability are required. Dr. Hugo Müller, in a report on the substance, says: "It seems that balata is by no means neglected, and, in fact, it

would find ready purchasers if more of it came to the market. It commands a higher price than gutta-percha. It is used in almost all cases in which gutta-percha is used, but, on account of its higher price, only for superior purposes. It seems that balata is treated by the manufacturers simply as a superior kind of gutta-percha, and, therefore, its name disappears when manufactured. Nevertheless, balata is distinctly different from gutta-percha, and this is especially manifested in some of its physical characters. For instance, it is somewhat softer at ordinary temperatures and not so rigid in the cold. In one respect balata shows a very marked and important difference from gutta-percha, and that is its behavior under the influence of the atmosphere. While gutta-percha, when exposed to light and air, soon becomes altered on the surface, and changed into a brittle resinous substance into which the whole of the mass is gradually converted in the course of time, balata, on the other hand, is but slowly acted upon under these circumstances. The electrical insulating quality of balata is said to be quite equal to that of gutta-percha." The price for pure milk is approximately a dollar a gallon, and for clean, well dried balata 25 cents per pound. The yield of a tree varies according to circumstances. If favorable, a tree 15 inches to 20 inches in diameter, bled 8 feet high, will yield three pints of milk.

Hyde Park (Ill.) Electric Light Plant.

An admirable specimen of a plant, intended largely for house lighting, is that to be found in Hyde Park, Ill., one of the recently annexed suburbs of Chicago, and illustrated herewith. The station itself is at Fifty-third street, near the lake front, and is a substantial brick building, well fitted and equipped with an installation of the latest pattern. The dynamo room is equipped with two 30-light Thomson-Houston arc dynamos and two 1,500-light Thomson-Houston alternators. These are directly connected to a pair of McIntosh & Seymour compound engines of 150 h. p. each. The dynamo room is neatly finished in hard wood and very conveniently arranged.

Fig. 1 shows the general appearance of the room, and Fig. 2 the switchboard, a compact and finished piece of work. Separated from the dynamo room by a fireproof wall is the furnace room. This contains two large boilers fitted with Murphy smokeless furnaces and Rooney stokers. The smoke-consuming device works very well, and is necessary in a station situated so near to an important residence district. The coal can be delivered at the very door of the boiler room, directly from the lines of the Illinois Central Railroad. The circuits are all carried from the switchboard to the distributing tower on the roof and from there reach out over the city. The pole lines are of special neatness. The poles themselves are of selected wood from 40 to 65 feet high, perfectly straight and smoothly tapered, and neatly painted. They carry from one to five cross-arms, between which the wire is drawn taut as harp strings. The lines running north and south are entirely in the alleys, and even the east and west lines are kept off the streets as much as possible, running, frequently, across the back lots. There is no obtrusive overhead work at all, and one hardly realizes that an electric light plant is in the vicinity except by the lamps that appear here and there. Over 50 miles of Simplex wire has been used in the installation, and is kept as thoroughly out of sight of the passer-by as even an advocate of underground systems could reasonably expect. The service is excellent, and the plant has proved a great convenience to those dwelling in the neighboring portion of the city. Hyde Park is one of the favorite suburbs of Chicago, and contains some of the finest residences, many of which have already introduced incandescent lights.

Altogether this is one of the best specimens of a well installed, well managed and thoroughly successful plant that can be found in the West.

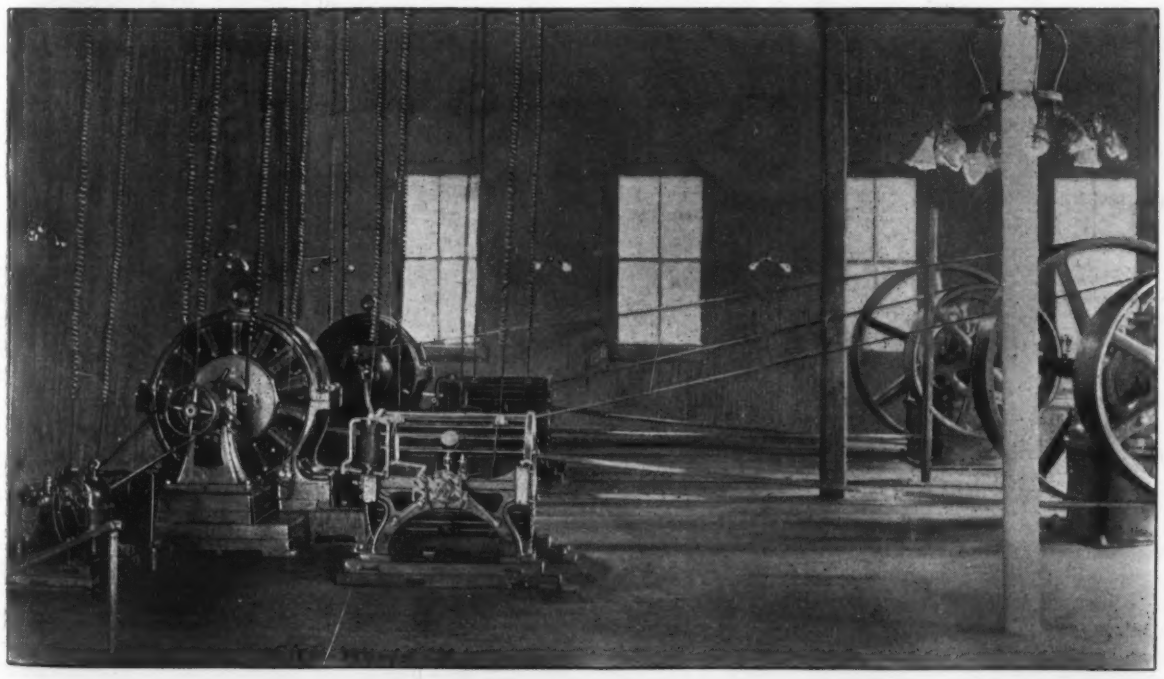


FIG. 1.—DYNAMO ROOM OF THE HYDE PARK (ILL.) ELECTRIC LIGHTING STATION.

Note on Some Lately Manufactured Telephone Cables.

BY FREDERIC A. C. PERRINE.

We are constantly using the telephone over both long and short circuits, and it is largely from the telephone "expert" that the modern electrical engineer was developed; yet to-day there is no department in electrical engineering concerning which accurate knowledge is so little diffused and difficult to obtain as that of the details of a telephone exchange, the requirements of the instruments, the switchboard and the line.

The electrical measurements of the lately opened London and Paris telephone line were published in all the journals, and a report of the tests with the different instruments; but to a majority of our electricians these data afforded little basis for comparison.

In England to-day, and, within a few years, in this country, a well-insulated line meant invariably one in which the wire is covered either with rubber or gutta-percha, and, except in long submarine cables, little attention was paid to the retardation due to capacity. Accordingly, on the introduction of the telephone, by reason of the multiplication of wires, and the consequent demand for underground circuits, cables were made and laid of rubber and gutta-percha-covered wire.

In spite of every precaution it has been found impossible to keep the gutta-percha from oxidizing unless laid under water and in the dark. The rubber cables have stood better, but in these as they were originally made two defects have developed, and one has proved insurmountable. In the first place, on account of the parallel laying of the conductors, in spite of the highest insulation, it was possible to talk from one wire to another by static induction. This defect was readily overcome by using an entirely metallic circuit and twisting together the two wires composing it into pairs, but the second defect has been found to be one inherent in the use of any solid insulation, such as a gum-like gutta-percha or rubber.

On account of the high specific inductive capacity of these materials, it is found that a retardation of the electrical waves is produced which soon muffles and finally effaces entirely all articulate speech.

Investigating this phenomenon, Prof. Jacques, of Boston, has found that for a Blake transmitter the limit of speaking is reached when the product of the resistance by the capacity of the line reaches 2,000, and for the long distance or Hunnings transmitter the limit is reached when this product becomes 4,500. Of course beyond these limits experts can do some talking, and Prof. Preece, of London, places the latter figure at 6,000. But the figures of 2,000 and 4,500 represent more nearly the limits in every-day practice.

In the case of any telephone cable, therefore, the requirements are a low conductor resistance, and at the same time the lowest static inductive capacity. These requirements are necessarily limited by the mechanical construction due to the size of the ducts available and the cost of manufacture.

In all of our cities subways have been laid having ducts from 2 inches to 3 inches in diameter, and in consequence cables must be made of diameters not exceeding 2⅛ inches, and, indeed, it is preferable that a diameter of 2¼ inches be not exceeded for a 3-inch duct, or 2⅛ inches for a 2½-inch duct, on account of the necessary internal irregularities of the iron pipe.

Now taking these external dimensions, it has been found that if the conductors be insulated each to one-eighth of an inch, then in the 2¼-inch cable 60 pairs can be nicely laid, allowing one-eighth of an inch for the thickness of the lead, and in the 2½-inch cable it is possible to lay 83 pairs, allowing in each of these one extra pair for possible defects in manufacturing or laying. These cables have been adopted as the standard in size and insulation, and the next question to be settled has been the size of the conductor.

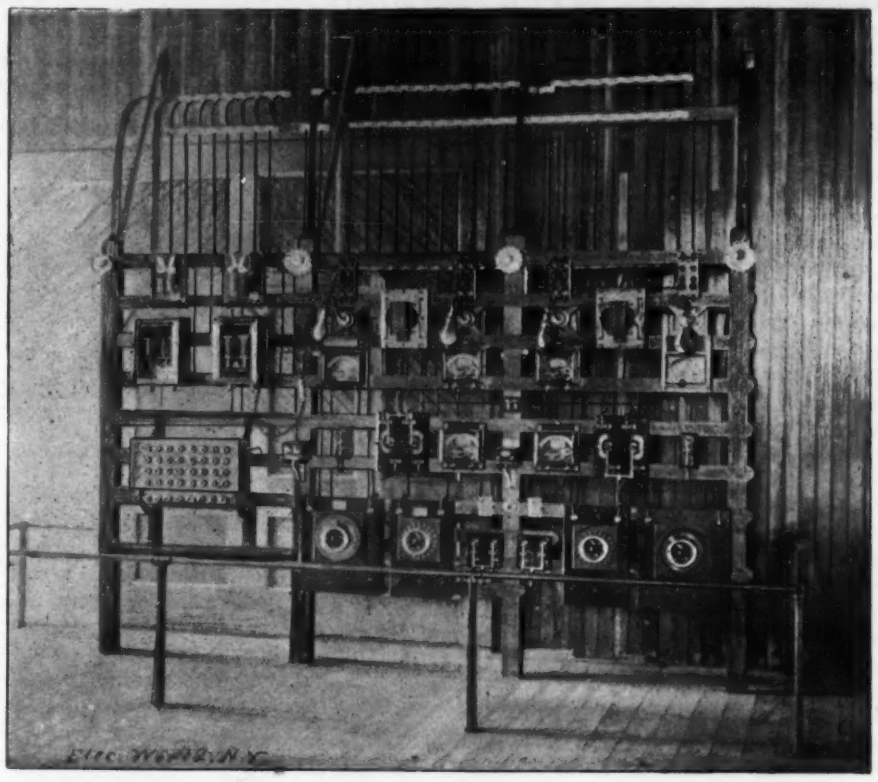


FIG. 2. SWITCHBOARD OF THE HYDE PARK (ILL.) ELECTRIC LIGHTING STATION.

No consideration of heating is here necessary, and the loss of potential on account of the resistance is also a small factor in comparison to the retardation from the high capacity. The use of the finest sizes of wire has been found inadvisable on account of the difficulty of manipulation in manufacturing and splicing in the manholes. No. 18 B. & S. gauge soft copper wire, with a maximum resistance of 36 ohms per mile, was accordingly adopted, and has been the standard for several years. By reason of the rapid extension of the telephone exchanges in cities and the consequent small importance of the resistance of the cables the size has been reduced, at the last Telephone Conference, one gauge, and now stands at No. 19 B. & S., with a maximum resistance of 46 ohms per mile.

With now the external diameter, the diameter of the insulation and the diameter of the conductor all fixed, the problem presents itself that the insulating material be used which will secure the lowest capacity, and hence the best circuit for talking.

Dense gums such as rubber and gutta-percha, as we have said before, give, with the cable indicated, a capacity of .3 micro. per mile, or the equivalent of 110 miles of pole line composed of No. 12 B. & S. hard drawn copper wire strung 36 feet in the air. Besides, both the great cost and unreliability of these materials render their use undesirable.

The first advance that was made was the use of cotton artificially dried and saturated with paraffine. By this means, capacities from .2 to .18 have been obtained, and this, with the cotton and rosin oiled cable led the Telephone Conference to reduce their specifications to .18 demanded, or the equivalent of about 67 miles of pole line.

The next step in advance was the use of dry cotton without any saturation whatever. Here a capacity as low as .1 to .11 was obtained, and the pole line length of a mile of cable reduced to 37.

At about this time we commenced a series of experiments at the Roeblings', with a view of determining any possible lowering of this capacity still further, and as a result we have succeeded in making and laying two cables, one in Boston and one in New York, of No. 18 B. & S. wire, of which the capacities after laying are measured as .082 and .081 respectively, with a wire resistance of 33.6 ohms per mile, or in the case of the New York cable a retardation equivalent to 28 miles of pole line. With the smaller sized wire lately specified, this retardation should be reduced at least five per cent.

By reason of these high results, the last conference reduced its specifications to an average capacity of .085, with a maximum of .09.

With a cable such as we have laid in New York, the conductor resistance being about 33.6 ohms and the capacity .081, the product of the resistance by the capacity is 2.7216 per mile, and through such a cable one could talk about 736

miles with a Blake transmitter, or about 1,650 miles with a Hunnings.

This represents not only the best results obtainable in fair weather under the best conditions, as is the case with a pole line, but the every-day practice, whatever the weather. This consideration, together with the total absence of cross-talk, for which these cables are rigorously tested with a breaking induction coil, render the cable of to-day no longer a bugbear, but a comfort to both the manager of the telephone exchange and its subscribers.

Electrolysis by Means of the Alternating Current.*

BY DR. GUGLIELMO MENGARINI.

The fundamental laws which regulate electrolysis by means of the alternating current are as follows:

1. The quantity of electrolyte decomposed by the alternating current is always less than that decomposed by a direct current of equal strength, and depends upon the current density at each of the electrodes; the greater the density the greater being the quantity of electrolyte decomposed.

2. There exists a limiting current density below which electrolytic decomposition does not take place. This density varies for different electrolytes and electrodes of different materials.

3. The amount of the electrolyte decomposed decreases as the rapidity of the alternations increases.

4. A limiting value to the rapidity of alternation exists, beyond which decomposition does not take place.

In order to establish the truth of these laws, it is not necessary to formulate any special hypotheses; it is sufficient to consider the phenomena which must be produced by an alternating current in a conductor capable of polarization.

Suppose we have a circuit traversed by an alternating current which follows a harmonic law; let i be the current at any time t, and I the maximum intensity; then

$$i = I \sin \pi t / T, \qquad (1)$$

where T is the interval contained between consecutive instants at which the current value is zero. A voltmeter is inserted in the circuit, so arranged that both its resistance and that of the circuit can be varied at will, so that while the current is maintained constant the pressure between the poles of the voltmeter can be varied as desired. To begin with, a very large resistance is inserted in the external circuit, so that the influence of the voltmeter on the total circuit is small, and the difference of potential at its poles can be made to approach that occurring with an equal inductionless resistance. The value of this difference of potential at any time will be approximately represented by the expression $e = I R \sin \pi t / T$, R being the resistance of the voltmeter. Suppose that, with the units adopted, R is numerically less than unity, then the maximum ordinates of the new sinoidal curve will be less than those given by (1). We thus get the two curves $O\,A\,T$, $O\,B\,T$ (Fig. 1), corresponding in phase, the former representing the change in current, the latter that of the potential difference at the voltmeter poles.

Whether we admit that electrolytic decomposition can take place with any electromotive force, or say that separation cannot occur when this force falls below a certain value, it is certain that we must consider polarization at any instant as an electromotive force opposite in sign to e, and commencing either with or after the intensity phase.

But if in the following reasoning it is desired to assume that electrolytic separation cannot take place below a certain electromotive force, no alteration will have to be made. The same arguments will hold good, the only difference being, as is readily seen, that a deformed instead of a sinoidal curve must be taken to represent the polarization. It is known that polarization takes place in voltmeters traversed by currents of very short duration,† in the discharge of condensers,‡ and with currents so small that no bubbles of gas make their appearance on the electrodes.§ For currents lasting only a short time, the polarization increases in proportion to the current and the time,‖ so that the electromotive force due to polarization can be represented by the expression

$$-\mathrm{P}\int i\,dt,$$

where P represents the electromotive force generated by the passage of unit quantity of electricity through a voltmeter such as that considered, of which the electrodes contain unit area.**

If p, then, is the polarization at any instant, we get by performing the integration

$$p = -2\,P\,I\,\frac{T}{\pi}\sin^2\frac{\pi t}{2T} \qquad (2)$$

which shows that the polarization is represented by a curve of double the period indicated on Fig. 1 by $O\,P\,2\,T$. The same thing is repeated during the second period of the alternating current. Starting from any instant we can thus obtain the polarization curve relative to that instant. It is clear, however, that after a very short time there must be a regular position for the curve, and this will accordingly be $P\,P'\,P'$.

* From *The Electrician* (London).
† Edlund, *Pogg. Ann.*, vol. LXXXV., p. 209.
‡ Becquerel, *Compt. Rend.*, vol. XXII., p. 381.
§ Kohlrausch, *Pogg. Ann.*, vol. CXLVIII., p. 143.
‖ Oberbeck, *Wied. Ann.*, vol. XXI., p. 139.
** Kohlrausch, *l. c.*, p. 147.

In order now to obtain the curve for the difference of potential at the voltmeter terminals, we have only to combine the two curves $O\,B\,T\,B'\,2\,O$ and $P\,P'\,P'$, whence we obtain the sinoidal curve $V\,V'\,V'$, having a period equal to that of the two from which it was formed.

We see, then, that polarization, like induction, produces a retardation of phase; the curves for the current i and the potential difference v at the poles of a voltmeter traversed by an alternating current can be represented by the equations

$$i = I \sin \frac{\pi t}{T}, v = \frac{I\,R}{\cos a} \sin\left(\frac{\pi t}{T} + a\right),$$

where

$$a = \tan^{-1}\frac{P\,T}{\pi\,R}$$

The expression found for v shows that the phase of the difference of potential at the poles of a voltmeter traversed

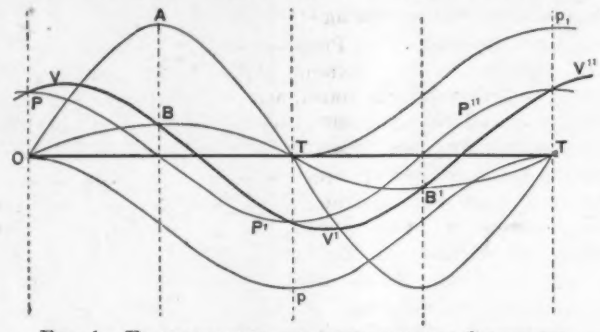


Fig. 1.—Electrolysis by Alternating Currents.

by an alternating current is moved forward with regard to that of the current strength, just as in the effect produced by induction, so that we may say that the insertion of a voltmeter in an alternating current circuit is equivalent to putting in a conductor possessing induction.

It should be observed that although we have hitherto spoken of polarization without decomposition of the ions, still we have implicitly admitted the fact that polarization increases in proportion to the polarizing current. As this is not the case, the curves $P\,P'\,P'$ and $V\,V'\,V'$ will not be really sinoidal, at all events as regards the longer ordinates, but, nevertheless, the reasoning given holds good. For any electrodes and electrolytes there exists a limit at which the products of decomposition commence to appear.

If we consider the case of the electrolysis of water as affected by two platinum electrodes exactly equal, and placed under the same conditions with regard to the flow of force between them and all other influences, and further grant, for the sake of simplicity, that the polarizations due to hydrogen and oxygen are equal (although it is not quite certain that they are so, the values found for them by different observers exhibiting slight differences), we can then denote by the two lines $C\,D$, $E\,F$ (Fig. 2), which are parallel to and equidistant from the axis of abscissæ, the limits which must be reached by the polarization of any given element before the giving off of gas commences.

If the current density at the electrodes is such that the polarization reaches and exceeds this limit, the polarization curve can no longer present the sinoidal shape shown in

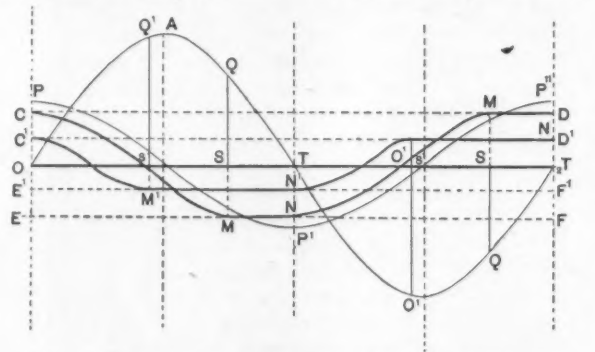


Fig. 2.—Electrolysis by Alternating Currents.

$P\,P'\,P'$ (Fig. 1), since no ordinates greater than $O\,C$ and $O\,E$ (see Fig. 2) can exist. From the instant at which the polarization attains at the point N the value $O\,E$, the liberation of gas will commence and will continue until the end of this period at N. In the interval between M and N the polarization cannot increase, and its course is, therefore, represented by a straight line parallel to the axis of abscissæ and at a distance $O\,E$ from it. From this point the polarization diminishes according to a sine curve until it reaches the value zero at O'. Changing sign here it again reaches at M the limiting value $O\,C$, when the liberation of gas recommences, ceasing again at N, *i. e.*, at the time $2\,T$.

Thus during each alternation there is a fraction of the time in which electrolysis proceeds regularly, just as with a direct current, while during the remainder it does not take place at all. The quantity of the electrolyte decomposed at each alternation will be proportional to the area $Q\,S\,T$. Comparing this with the total area of the curve $O\,A\,T$, which represents the quantity of electricity passing through the voltmeter in the time T, we see that the amount of the electrolyte decomposed by an alternating current must be less, except in the limiting case when the line $C\,D$ coincides with the axis of abscissæ, than that obtained with a direct current of equal quantity.

INFLUENCE OF THE CURRENT DENSITY AT THE ELECTRODES.

Increasing the current density at the electrodes increases the polarization, so that the limit of polarization necessary to produce electrolytic separation is reached in a shorter time. This is equivalent, as is shown diagrammatically in Fig. 2, to giving a lower value to the ordinate of the straight lines $C\,D$, $E\,F$. If, for instance, this ordinate is reduced to half its value, we thus obtain the two lines $C'\,D'$, $E'\,F'$; $O\,C'$ and $O\,E'$, being half of $O\,C$ and $O\,E$. If we suppose that to increase the current density at the electrodes their area is diminished, while the current strength and the rapidity of alternation remain unaltered, the maximum ordinate $P\,I\,T/\pi$ of the curve, representing the polarization inside the voltmeter, will still have its original value, so that while the polarization curve $P\,P'\,P'$ will still be identical with that already found, none of its ordinates will be able to exceed $O\,C'$, so that the liberation of gas will commence at M' and cease again at N', and the amount of the electrolyte decomposed at each alternation will be proportional to the area $Q'\,S'\,T$, which is not only larger but is more than twice as great as the area $Q\,S\,T$.

The same result will obtain if we suppose the area of the electrode to remain constant while the current traversing the voltmeter is made to vary. The maximum ordinate of the curve representing the course of polarization will increase with the current, and the quantity of the electrolyte decomposed will increase still more rapidly in relation to the current density than it was found to do in the case considered above.

Therefore, in general, the quantity of an electrolyte decomposed by an alternating current when the current varies, the surface of the electrode remaining constant, is not proportional to the current passing through the voltmeter.

If the current varies as a sine, and remains constant while its density at the electrode is made to vary, the quantity of the electrolyte decomposed at various current densities will be represented by the area inclosed by that portion of the curve contained between the respective moments t_0, at which electrolysis commences, and the time T, and the quantity of the electrolyte decomposed is to that decomposed by a continuous current, which causes the same quantity of electricity to pass through the voltmeter, as the area inclosed by that portion of the sine curve included between the times t_0 and T is to the total area contained by the portion representing a whole alternation, that is, as

$$\cos^2\frac{\pi t_0}{2T} : 1.$$

If the ordinate of the lines $C\,D$, $E\,F$ has the value $O\,P$ (Fig. 2), electrolytic decomposition can evidently not take place, so that there exists a limiting current density below which decomposition must cease, the voltmeter only becoming heated by the passage of the current like an ordinary metallic conductor.

Although there is a certain total polarization in the voltmeter, the current density at each of the two electrodes must be considered separately. The ordinate of the lines $C\,D$ and $E\,F$ (Fig. 2) may be different from the two electrodes, since they may be under different conditions; so that while one decomposes a sensible quantity of the electrolyte the other does not. If for the special form of the electrodes or of the voltmeter the current density is not uniform, the ions will appear only at those portions of the electrodes where the current density is greatest. This will serve to explain the anomalies found by Ayrton and Perry in examining with a Hoffman voltmeter the decomposition of water by means of an alternating current.*

From the above it is clear that it is much easier to effect by means of an alternating current of sufficient density the decomposition of water, or any electrolyte giving gaseous ions, than that of one of which one of the ions is solid. And it is on account of this greater difficulty in the case of salts that many persons even now maintain that electrolytic decomposition of saline solutions with the alternating current is impossible.

* *La Lumière Electrique*, vol. XXIX., p. 101.

The Fatigue of Metals.

With respect to statements that occasionally appear on the subject of the fatigue of metals under long continued stress, a report that has recently been published regarding two similar suspension bridge links is worthy of notice. A square iron link, 12 inches wide, 1 inch thick and about 12 feet long, says *The Electrician* (London), was taken from a bridge at Kieff, then about 40 years old, and tested against a similar link which had lain unused in store ever since the building of the bridge. The means of comparison were, therefore, excellent, and the result should go a long way to show whether or not iron really does lose any of its strength in prolonged service. The effect of the tests was to determine for the old used link an ultimate tensile strength of 21.8 tons per square inch, an elastic limit of 11.1 tons per square inch, an elongation of 14.05 per cent. and a contraction of 17.35 per cent. at the point of fracture. For the unused link the tensile strength was found to be 22.2 tons per square inch, with an elastic limit of 11.9 tons, and elongation and contraction at fracture of 18.42 per cent., and 18.75 per cent. respectively. The two pieces of iron were, therefore, of practically identical strength; for the small difference actually observed is well within the ordinary range of variability of similar pieces of the same metal.

The Press as a News Gatherer.*

BY WILLIAM HENRY SMITH.

The modern American newspaper had its beginning in New York. It was here that it was first clearly demonstrated that newspaper publishing could be divorced from the fortunes of a public character or of a party, and made a profitable business.

Up to the year 1849 the individual papers continued to collect news without co-operation. A news-boat system had been introduced by the *Courier and Enquirer*, but as this was a temptation to collusion, it failed to receive public confidence. During this year a "Harbor News Association" was formed, the leading members of which were the *Journal of Commerce* and the *Herald*, and subsequently telegraphic and general news associations were organized for the purpose of covering a wider field. These undoubtedly had their origin in the success of the *Herald* and the *Sun* in getting through from Texas and Mexico, during the progress of the war, dispatches by pony express in advance of the government's advices. It was manifest to the conductors of other newspapers that if they were to compete successfully with the new system inaugurated by Mr. Bennett they must adopt new methods. Negotiations were entered into, and in 1851 the present "New York Associated Press" was organized under the following agreement:

"It is mutually agreed between G. Hallock, of the *Journal of Commerce;* J. and E. Brooks, of the *Express;* J. G. Bennett, of the *Herald;* Beach Brothers, of the *Sun;* Greeley and McElrath, of the *Tribune*, and J. W. Webb, of the *Courier*, to associate for the purpose of collecting and receiving telegraphic and other intelligence."

The *Times* and *World* came in later—the latter under the *Courier* franchise—and since their accession there has been no change in the membership of the "New York Associated Press."

Even at this time the electric telegraph, which had introduced a new element in the making of newspapers, was used sparingly because the facilities were inadequate to a large business, and because the income of the best papers did not yet justify incurring extraordinary expenses. The mail, the express and carrier pigeons were still the principal means for collecting news. The people had not yet acquired the intense habit that exacts uninterrupted service. That came with the great war.

As the telegraph has become the most serviceable of all agencies in the gathering of news, we may properly devote brief space to its development. In 1838 Morse and his associate, Alfred Vail, who were endeavoring to enlist the aid of the national legislature, gave an exhibition of the working of the electric telegraph in Washington. In an invitation to a Senator to be present, the confident prediction was expressed that it would be practicable to get quotations of the New Orleans cotton market every day. And when Henry O'Rielly's lines (known as the "Atlantic, Lake and Mississippi Telegraph" reached St. Louis in 1849, a national telegraph and railroad convention was held in that city, which adopted an elaborate report recommending the immediate construction of a telegraph line to the Pacific Coast. The gold fever was at its height, and the Western people were impatient on account of the slow method of communication across the plains, or via Panama. Mr. O'Rielly's plan was not brought to the attention of Congress until the session of 1851–2. It proposed that Congress should pass a law providing that instead of establishing forts, with hundreds of men at long intervals apart (as suggested by the War Department), the troops designed for protecting the route should be distributed in a manner better calculated to promote that and other important objects on the principal route through the public domain; namely, by stationing parties of 20 dragoons at stockades 20 miles apart. It provided also, that two or three soldiers should ride daily, each way, from each stockade, so as to transport a daily express letter-mail across the continent, protect emigrants, and incidentally the construction of a telegraph to California. At this time the line had been carried into New Orleans, and the O'Rielly system included 7,000 miles of wire. This was scarcely 40 years ago, and yet to-day the system of the Western Union Telegraph Company embraces 680,000 miles of wire, and all American companies combined more than enough to girdle the world 27 times. At the close of the war this great company controlled 75,686 miles of wire, and distributed business through 2,250 offices. In 1876 the system had been extended to 183,832 miles of wire and 7,072 offices; in 1881 to 327,171 miles of wire and 10,737 offices, and in the last ten years the mileage and offices have been doubled. For many years the use of the wires in the collection of news scarcely kept pace with the growth of facilities. The business of the newspapers hardly justified lavish expenditures, and telegraphic rates continued to be high. Therefore the wires were employed only for brief mention of the most notable events of domestic news within a radius of a few hundred miles. The readers of newspapers had not yet outgrown the deliberate movements of the Post Office Department. The exigencies of journalism in that day did not require the immediate and unrestricted use of the telegraph in all cases.

The telegraph companies were the pioneers in the news collecting and distributing business West and South. In 1860 the telegraphic reports scarcely exceeded fifteen hundred words a day for such cities as Pittsburgh, Cleveland, Cincinnati, Detroit, Chicago and St. Louis. The files of the Charleston *Mercury* show even less for the South. The cotton markets of New Orleans and New York, brief mention of the latest European dates by steamship and briefer even of Congress made up the variety.

All of this changed with the breaking out of the war. The "Associated Press" supplemented its reports of routine business with accounts of the movements of troops, of the transactions of departments, and with patriotic appeals; while the great journals of the principal cities inaugurated special correspondence from the fields of battle which increased their popularity and made the reputation of many able writers. People acquired the habit of reading daily papers, and new and improved machinery was constructed to meet the increasing circulation.

In the Associated Press system New York is the principle centre. From it extend to the east, to the west, to the northwest, to the south, and to the southwest, its leased wires exceeding 10,000 miles in length, which are operated under its own direction, and over which an enormous amount of report is received each day. It is thus practicable for the management to have as direct and prompt intercourse with agents in all of the great cities as with persons in the same office; or with the papers of Boston, Minneapolis, Denver, New Orleans and other intermediate cities as quickly as with the papers of New York City itself. Here is first received the foreign news, except such as comes from China, Japan and the Samoan Islands through San Francisco; reports of the commercial transactions of Europe, India and Australia; of debates in Parliament, in the Reichstag, in the National Assembly or Cortes; of industrial and social movements; of the achievements of science, etc. At its office in London, Berlin, or Paris is delivered for its use, as may be most convenient, the news collected by the great news agencies of Europe—Reuter, Wolff and Havas and their allies, with which the Associated Press has exclusive contracts. In addition to these, the resources of the Central News of London and the English Press Association are at the service of the Associated Press, which also employs special correspondents in the principal capitals of Europe to collect intelligence of distinctively American interest. These dispatches are clearly and concisely expressed, except on occasions of unusual interest, when they are treated as elaborately as domestic reports. Market quotations are always transmitted by cable in an elaborate cipher, to insure accuracy and economy. These are promptly interpreted, verified and sent out to the press and the various commercial exchanges.

Figures will give a clearer idea of the extent of the work performed daily by the Associated Press than any other form of description. The New York office handles daily from 75,000 to 100,000 words, equal to from fifty to seventy columns of matter. On January 13, 1891 (a date taken at random), this news amounted to 95,000 words. Of course, of this mass of material no paper prints the whole; but most of it finds a place somewhere. To meet the requirements of the service, the Associated Press adapted the type-writer to receiving directly from the Morse instrument, and a special paper was made which facilitates the handling of reports. These details may seem of small moment, but they go to show the pains taken to insure perfect work. The agents of the Associated Press, who are selected for character and ability, are instructed to get all of the news, but if need be to sacrifice the "story" to the facts—in a word, to tell the truth. They are required to treat all political and religious events with judicial fairness, and to omit social happenings having an immoral tendency. We do not find that anything is lost to thorough journalism by such limitation, but on the contrary much influence is gained thereby. The Associated Press enjoys the public confidence in its reliability to a degree unapproached by any other organization, and this enhances the value of the franchises of the papers supplied by it. This confidence is based upon an experience of forty years.

The enterprise of the Associated Press has been equal to every emergency. It began to make verbatim reports of the great national conventions of the political parties in 1872. Its descriptions of the scenes occurring in the halls during the sessions of the various conventions were made with such photographic accuracy as to give to the readers of the newspapers in distant cities a clearer idea of what was said and done than was possible to most persons who were actually present. The stenographers, typewriters and operators followed the speeches and transactions with such rapidity and precision that within fifteen minutes after the close of each session of 1880, 1884 and 1888 the last sentence was delivered to the papers in the various cities. When Mr. Cleveland was nominated in St. Louis, the Associated Press bulletin announcing the fact was put upon the Western Union wires, and was on the bulletin boards of the newspapers of San Francisco and other cities in less than two minutes. And, as a rule, announcements of this kind are generally displayed on the bulletin boards of the newspapers before the fact is known in the convention; the Press reporters keeping tally of the vote do it more quickly than the secretaries of the convention, and generally have the result on the wires before the footing is handed to the reading clerk.

The dynamite explosions of Westminster Hall and London Tower, in the winter of 1885, occurred between two and three o'clock in the afternoon. By 10 o'clock, New York time, the forenoon of the same day, a bulletin reached the Associated Press announcing the explosion. That was hardly written and sent to the papers before the details began to follow in frequent dispatches. So quick was the service, that one New York afternoon paper before noon had an "extra" on the street with a half-column report of the outrage, while the last editions had accounts filling several columns.

Mr. Gladstone made his great speech in Parliament in support of his famous Irish bill on the evening of June 7, 1886. The Associated Press cabled from London 13,000 words of this speech, giving large parts of it verbatim. It was doubtless the largest single cable dispatch ever sent across the Atlantic. The orator finished speaking soon after 10 o'clock, London time. By the same hour, New York time, ten columns of his speech and of description of scenes and incidents were in every important newspaper office in the United States.

The reader will recall the graphic account of the destruction of ships in the harbor of Apia by Mr. John P. Dunning, a staff correspondent of the Associated Press, who had been sent to investigate the political complications in Samoa; the reports of the great flood in the Conemaugh Valley; the report of the destruction of a part of Louisville, and more recently the accounts supplied of the Liberal dissensions in Great Britain, and of the Indian troubles in Dakota.

We have thus far considered only what is known as the "regular" service. The special service of the great newspapers of the principal cities is very large and expensive, and the editor of each is justly proud of what he has accomplished in this field. This spirit of enterprise gives an individuality to the journal which, in a notable case such as Mr. Bennett's sending Stanley to Africa, endures for many years. The *Tribune*, the *Times*, the *World* and the *Sun* of New York have scored their memorable "beats," and so have the newspapers of Boston, Philadelphia, Baltimore, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Louisville and San Francisco. But aside from notable occasions this special service has been and continues to be widely extended, covering not only political correspondence from the national capital, but also a great variety of social, business and political events in the States and Territories. Money is not spared to meet the demand of the reading public. A great journal will spend for this class of news between $8,000 and $9,000 a month, or $100,000 a year in round numbers.

The records of the Western Union Telegraph Company may be consulted to show the extent of the expenditures by the individual newspapers and the Associated Press for telegraphic tolls alone on this the largest telegraph system.

During the year ending June 30, 1890, the Western Union Telegraph Company delivered at all stations 322,088,438 words of "regular" or Associated Press report. This was delivered to an average of two newspapers in each place, at an average cost of 15 cents per 100 words for each place.* During the same period the company handled 206,025,094 words of specials, at an average cost of 51 cents per 100 words. These figures do not include reports transmitted by the Associated Press over its leased wires, or special correspondence sent on individual newspapers' leased wires. Estimating these two classes and the reports of the outside press, there was delivered to the newspapers during that year an aggregate amount of 1,500,000,000 words of telegraph news. On the regular service a little more than twenty-two per cent. is handled by the telegraph company in the day time, while on the special service only about five per cent. of the volume is handled in the day time. The day rate is twice the night rate. On the Associated Press leased wires the proportions are thirty-four per cent. of day report to sixty-six per cent. of night report, and the difference in cost the same as by Western Union lines. The total press receipts by the telegraph company for the year ending June 30, 1890, including regular, special and leased wires, were $1,848,247.23.

It should be borne in mind that these figures do not include tolls on other lines, or cable tolls, or the wages of correspondents and operators, or miscellaneous expenses, or the sums paid for news by both individual newspapers and the Associated Press, which would aggregate a very large sum.

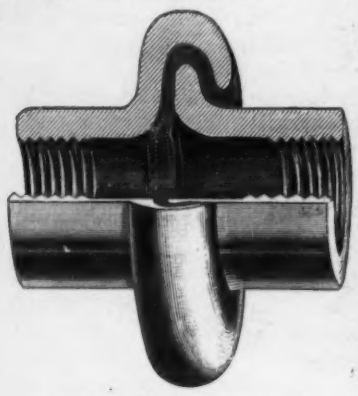
One very interesting feature of the news service, of which the public has no knowledge, is telegraphing in cases of storms and interruptions. It is on such occasions that the utility of a vast system is made manifest. During the blizzard of March, 1888, for instance, the Washington report was sent to Philadelphia via New Orleans, Memphis, St. Louis Chicago and Pittsburgh; while New York City received it from Albany, it having reached Albany via New Orleans, St. Louis, Chicago, Cleveland and Buffalo. A more extraordinary case is that of Boston, which received a condensed report from New York, via London, it being sent by one cable from New York to London, and thence back by another cable which lands in New Hampshire. Boston is frequently served with New York news via Montreal, and Albany via Pittsburgh and Buffalo, the route being via the Pennsylvania Railroad to Pittsburgh, thence across via Cleveland to Buffalo, and thence down the New York Central to Albany.

*Abridged from article under the same title in the August *Century*.

*This is rendered possible only by the great number of places served on a circuit—from thirty to forty being supplied in some cases at the same time.

The Prior Insulating Joint.

Those who are engaged in the electrical construction business are quick to appreciate and adopt any improvement in their line that is put before them. An improved joint for insulating chandeliers from the gas pipe where both gas and electricity are used is illustrated in this issue, and is of special interest to those who make the wiring of stores and houses a specialty. This insulating joint was designed and is being put upon the market by Matthew Prior, of Watertown, Mass. It is made of brass in two castings, insulated from each other by the best insulating fibre put in under a pressure of several tons and firmly held in place, thereby rendering the joint perfectly tight and secure from all action of gas or atmosphere. The joints are made in all the standard sizes, have no screws to twist, break off or cause short circuits, and are as strong as a solid casting. It has the approval of the electrical department of the Boston Fire Underwriters' Union.



INSULATING JOINT.

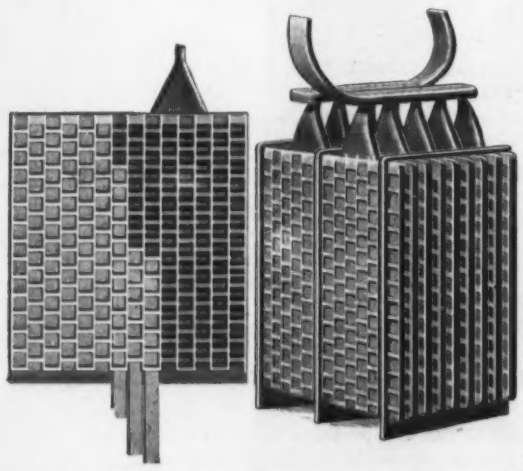
SOLDERING FURNACE.

A New Storage Battery.

The Bradbury & Stone Storage Battery Company, of Lowell, Mass., has, after a long series of experiments, perfected a storage battery that seems to overcome many of the obstacles that proved stumbling blocks to complete success in the past, and now feels that it is in a position to furnish the public with a battery that will do just what is claimed for it in every particular.

Fig. 1 shows a light hollow plate or electrode molded in one piece and braced in every part to insure its ability to withstand a high rate of charge and discharge without buckling, the danger of which, owing to the peculiar construction of the plates, is claimed to be entirely obviated. The plate is open at the ends for the insertion of the pencils or bars of the active material, which are made under hydraulic pressure. When the pencils are in place the lips of the plates are turned up, holding them in position.

Fig. 2 gives a view of the battery when set up, showing a unique contrivance for separation and support, combined in the form of a rubber grate one-eighth of an inch wide at the top, beveling to three-eighths of an inch at the base, making a very strong and substantial affair. It is said that tests of this battery made by disinterested electricians show an efficiency of over 92 per cent., and an exceptionally low internal resistance. Several installations have been made, and in every case these are proving entirely satisfactory.



FIGS. 1 AND 2.—BRADBURY & STONE STORAGE BATTERY.

The Chicago Trolley Clamp.

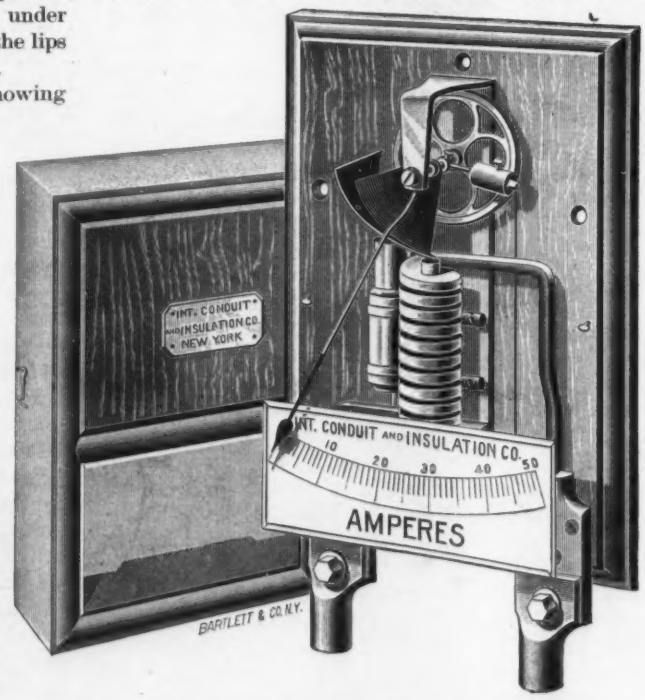
A very ingeniously designed trolley clamp suitable for general use, and which we illustrate herewith, is the invention of Mr. John S. Gustin, purchasing agent for the Electric Merchandise Company, of Chicago, Ill.

The clamp is formed in three distinct parts, two sections with opposing lips, one of which is provided with a threaded projection upon which the clamping nut is screwed; the other with a dog inclosed by the protruding lower rim of the nut. Through the lower portion of these opposing sections a groove is formed to contain the trolley wire, the size of which does not call for a different construction of the clamp. The opposite lips are cut at such an angle that they still engage each other when the largest trolley wire is inserted in the groove. The screwing down of the nut upon the threaded projection and over the dog causes the lips to slide one within the other, thus forcing together the lower sections of the clamp upon the wire, preventing all possibility of falling. The movement of the wire from expansion and contraction is provided for in the hinge joint included in the nut. With this clamp a reliable support is provided for the trolley wire, while at the same time its simple mechanism makes its adjustment at any place upon the wire or entire removal therefrom an easy task. The clamp is equally efficient whatever may be the style of insulator used in connection therewith. While possessing all necessary strength, the clamp is light and presents a neat appearance.

FIG. 1.—THE CHICAGO TROLLEY CLAMP.

The Johnson Dead Beat Ampere Meter.

The accompanying illustration shows a front view of this ampère meter with the cover removed. The instrument has just been placed upon the market by the Interior Conduit and Insulation Company of this city. The special feature claimed for it is its dead beat character, which is accomplished by the application to the already well-known ampère meter of this company of a dash pot of peculiar construction. In this dash pot the friction of the air on the piston is the only retardation to its movement; the friction therefore becomes a practically constant quantity. In the use of the instrument it is said that violent changes of current are instantly indicated and noted as readily as are gradual changes in the ordinary types of ampère meter. This feature renders it peculiarly useful in connection with stationary motors, and especially on electric railway power circuits. As the metal of the two interlocking pistons is never in actual contact, it would seem that no disarrangement could be possible, and that there would be no hindrance to the return of the needle to the zero point. The needle is actuated by an electromagnet, and its armature being always in a strong magnetic field is not influenced by currents in the immediate vicinity. The resistance of the magnetic coil is extremely low, that of a 25-ampère instrument, for instance, measuring only .005 of an ohm. The instruments are mounted upon mahogany bases with glass fronts and covers, or, if preferred, are finished with slate bases where it is desired to have an instrument with other than a wooden back.



THE JOHNSON DEAD BEAT AMPERE METER.

An Electrical Blast Furnace.

In his every-day work the electrical lineman and workman in electrical repair shops makes use of some sort of furnace in connection with the soldering of joints. The accompanying illustration will be of interest to this class of electrical workmen, representing, as it does, a blast furnace suitable for electric linemen's use. The oblong soldering pot accompanying it allows the user to solder together two ends of wire by simply springing the wire into the pot, thereby obviating any necessity of pouring the melted solder on the joint. The furnace is not affected by draught, and cannot be blown out even by a high wind. Although over 20,000 are in use no serious accident with one has ever been reported. The working parts are few and readily adjusted, and the furnace is easily kept in working order. It is claimed by the manufacturers, the Messrs. Haines, Jones & Cadbury Co., of 1,136 Ridge avenue, Philadelphia, that it will melt 10 pounds of solder in six minutes.

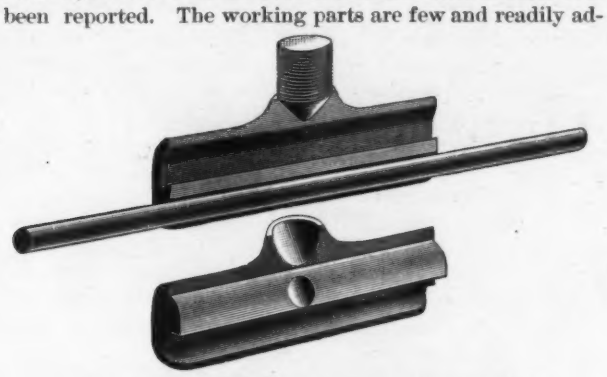
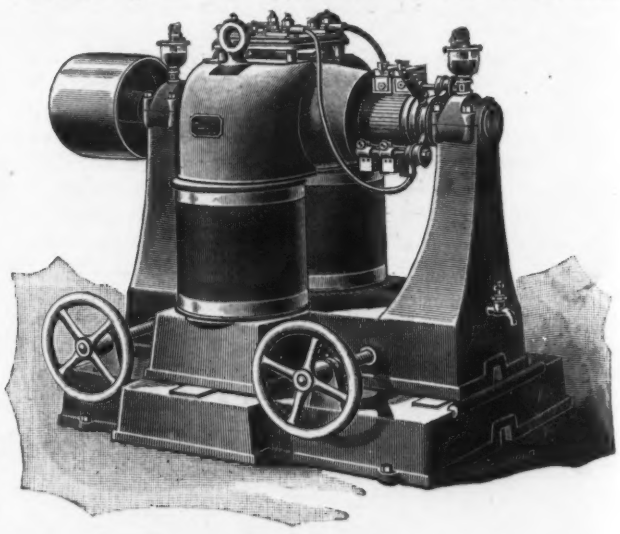


FIG. 2.—THE CHICAGO TROLLEY CLAMP.

The Canada Electric Company's Dynamo.

The accompanying illustration shows the dynamo designed by Mr. D. M. Bliss, electrician to the Canada Electric Company, of Amherst, N. S., for the low-tension direct-current system. It is manufactured in all sizes up to 40,000 watts capacity. In this machine the attempt has been made, and successfully carried out, to produce a dynamo having the desirable features of high efficiency, moderate speed, and of the greatest durability, and one that could be manufactured and sold at a comparatively low price. The base bearing standards and field cores are made in one casting of the best soft cast iron; the pole pieces are bolted to cores by extra long and heavy eyebolts, and are held in alignment by a heavy dovetailed joint, so that a large surface and an accurate joint is effected between core and pole pieces, thus reducing the magnetic resistance to a minimum. The field coils are wound on heavily insulated spools and slipped over the cores in the usual manner. The armature core is very strongly built and carefully wound, so as to stand the most severe accidental strains. It is of relatively large diameter, so that a moderate speed is required to obtain the requisite potential; the 20,000-watt dynamo requiring a speed of 1,200 revolutions per minute. The commutator is heavy and made of tempered copper. Carbon brushes are used and the brush holder is of an entirely new design, and the difficulties attendant upon the use of carbon in the unusual style of holder with heavy currents and low potential have been completely overcome. Thus in the No. 38 dynamo the current of over 180 ampères at 110 volts pressure is delivered without sparking and less heating than is usual with copper from one pair of brushes of only 2 inch × ½ inch face, or a total contact surface of 4 inches × ½ inch. As a consequence the commutator is maintained in perfect condition. The bearings are long and heavy and interchangeable, self-adjusting, and when desired self-oiling. Owing to the manner of casting the frame it will be seen that an ex-



THE CANADA ELECTRIC COMPANY'S DYNAMO.

tremely rigid and substantial effect is obtained and the cost of manufacture considerably reduced as well. The German silver coils of the rheostat used with this dynamo are wound on asbestos-covered iron forms inclosed in the perforated iron case so as to occupy but little space and have good ventilation.

These dynamos are made either plain shunt wound or compounded for any desired drop. For sizes above 40,000 watts and potentials greater than 110 volts a multipolar type of dynamo with ring armature is made.

New Trolley Wire Hanger.

The accompanying illustration, Fig. 1, shows a complete trolley wire hanger recently brought out by the Lieb Machine Works, of this city. Fig. 2 shows the method of construction. It will be noticed from Fig. 2 that the metal socket in which the clip screw fits is part of a ring imbedded in the composition, and the rivet which holds the iron hood to the insulator passes through this ring, being separated,

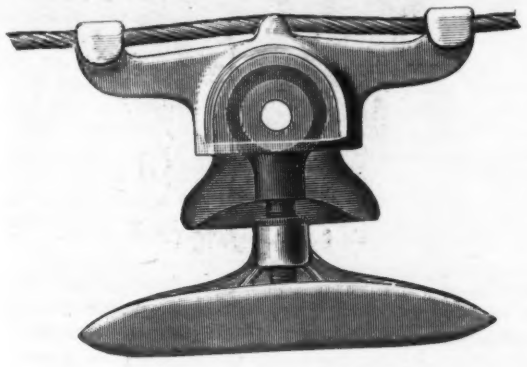


Fig. 2.—Lieb's Trolley Clamp.

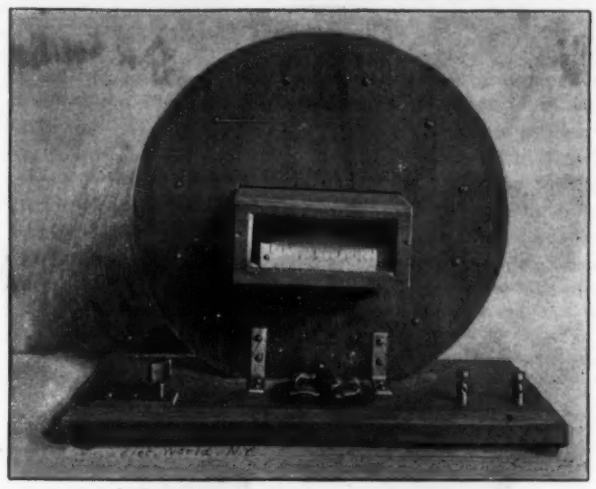
however, from it by the insulating composition. The advantage of this construction is apparent, since it absolutely prevents the insulator from dropping the trolley wire, no matter what accident may happen to it. Repeated blows of the trolley can break the composition, and even make connection between the span wire and the trolley wire, but the trolley wire is always supported by means of the rivet passing through the ring, so that there is no danger of the trolley wire falling in the street.

The clip is also of novel construction. It has two jaws hinged so as to clasp the trolley wire, and these jaws are forced together by means of a taper point on the screw holding the clip to the insulator, and which forces the jaws on the trolley wire. The clip is adjustable, and will fit any size of wire, from a number zero to a number four. In attaching, the insulator is first screwed to the trolley wire and then snapped in place on the span wire. By this construction the jaws of the clamp cannot become accidentally loose, since the clamp can only be opened by turning the insulator, which involves disconnecting it from the span wire.

An Electric Switch.

Of the many electric switches and commutating devices which appear every year, only a few possess special merit. Among these, however, may be classed the reversing switch shown attached to the above galvanometer. Its special features are, simplicity and ease of manipulation, while its small number of parts will admit of its being cheaply manufactured. Its mechanical design is also excellent.

This switch was invented by the late George Frederick Rowland, of Greenwich, Conn., for use in connection with



Rowland's Reversing Switch.

several measuring instruments of his design. Mr. Rowland was a cousin of Prof. Henry A. Rowland, of the Johns Hopkins University, and was preparing to enter the electrical course at Columbia College at the time of his death. This invention was only one of many original devices with which his workshop was filled, and had he lived it is more than probable he would have rendered material service to the science of electrical engineering.

The Commercial Production of Aluminium.

The commercial production of aluminium is no longer an experiment, and tons of it are now made for each ounce of a few years ago. It has long been known that this curious metal is one of the most plentiful in nature; but, owing to the difficulty in separating it from its combinations, aluminium has been classed among the precious metals.

With the invention of the Cowles process of electric reduction, and its further improvement by the Pittsburgh Reduction Company, the price has fallen to less than one-tenth of the current rate prior to these inventions.

The output of metal increases rapidly and constantly with its appreciation by manufacturers. The present capacity of the plant of this company, at Pittsburgh, Pa., is limited to 550 pounds per day of 24 hours, but extensive additions will soon increase the capacity.

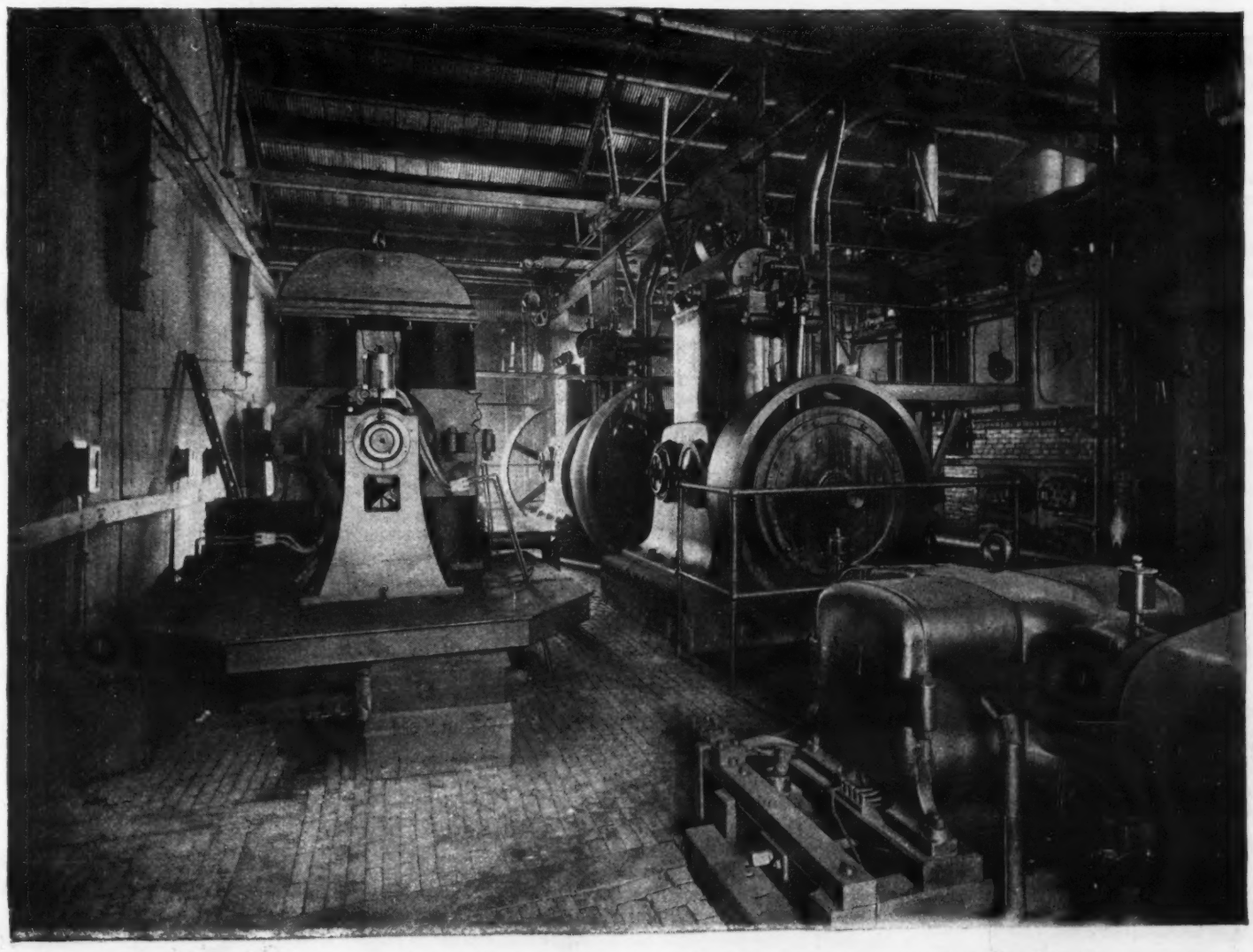
The process of its production is as interesting as peculiar, and is a perfect parallel to the electrolytic deposition of metals from an aqueous solution of their salts.

The ore to be reduced is an imported oxide of aluminium, and the medium for the solution and electric current is a melted triple fluoride kept at a red heat by its resistance to the current. Both poles are of carbon—the negative being a carbon-lined iron tank, and the positive a series of iron rods tipped with carbon, which is consumed gradually by the negative element of the ore. A curious feature of the process is the constant character of the fluoride bath, which remains unchanged no matter how long used. Only a moderate pressure of 10 volts is required to break the chemical union, but the quantity of metal deposited is directly proportional to the gravity of current.

This company's commercial success is dependent in a great measure on its ability to run the plant continuously for a long time. Recognizing the single-acting principle of the Westinghouse engine as well suited for its purpose, it

Fig. 1.—Lieb's Trolley Clamp.

has installed two Westinghouse high-duty compound engines of 200 h. p. each, which drive two Westinghouse shunt-wound dynamos in multiple arc, each generating 2,500 ampères of current at 50 volts pressure; also, one Westinghouse standard 125 h. p. engine, driving two Westinghouse shunt-wound dynamos in multiple arc, each generating 1,000 ampères of current at 25 volts pressure.



POWER ROOM OF THE ALUMINIUM PLANT OF THE PITTSBURGH REDUCTION COMPANY.

The accompanying illustration is a view of the interior of the company's power room reproduced from a photograph.

The MacMillan Primary Battery.

An improvement in the construction of primary batteries, the result of many years of study and experimentation, has recently been made and patented by Mr. William MacMillan, of this city. The invention consists of certain improvements in the construction of the porous cells, in the construction of negative elements and the combination with these of improved depolarizers. In addition to these improvements Mr. MacMillan has devised a new construction for a

receptacle for transporting the battery materials, of such a character that it can be used in conjunction with a cup or cell of the battery.

In the accompanying illustrations Fig. 2 is a vertical section of a complete cell of the primary battery constructed according to Mr. MacMillan's improved designs. Fig. 1 is a side elevation of the porous cup and covering, and a sectional elevation of the receptacle for battery substances. By reference to these illustrations the construction will be readily understood. The negative element of the battery, which in this case is of the single-fluid or sal-ammoniac type, consists of a carbon plate placed in a porous cell, while the positive element is a zinc plate placed outside the same cell. The porous cell and the elements are all already within an outer containing jar. The carbon plate is provided with slots within which a depolarizer in cakes or plates of suitable shape or form may be arranged, so as to virtually form part of the element or plate. The depolarizing material preferred by Mr. MacMillan for this purpose is manganese dioxide. The space between the carbon plate and the walls of the porous cell is nearly filled with small pieces of carbon, upon the upper surface of which a suitable sealing material, provided with vents, as shown, is placed. The porous cell shown in Fig. 1 consists of a perforated cup of stiff paper or cardboard, covered with a thin and porous fabric extending over the perforations in the cup. Ordinary coarse, heavy strawboard may be used for the perforated cup, and is prepared by immersing it in a solution of paraffine or other fluid-proofing solution, or by otherwise saturating or coating it with a fluid-resisting material. Ordinary cambric forms a cheap and efficient material for the covering of the perforated cell. The cardboard forms a strong cup, and the holes through

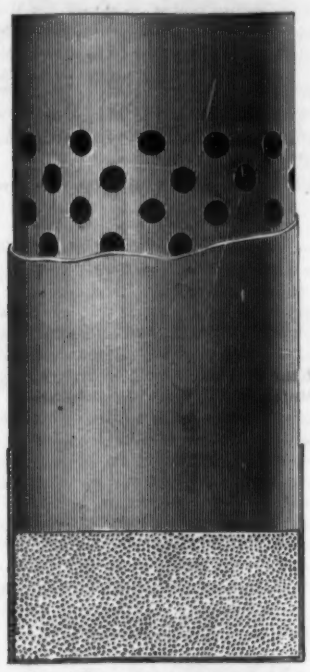


Fig. 1.—MacMillan's Primary Battery.

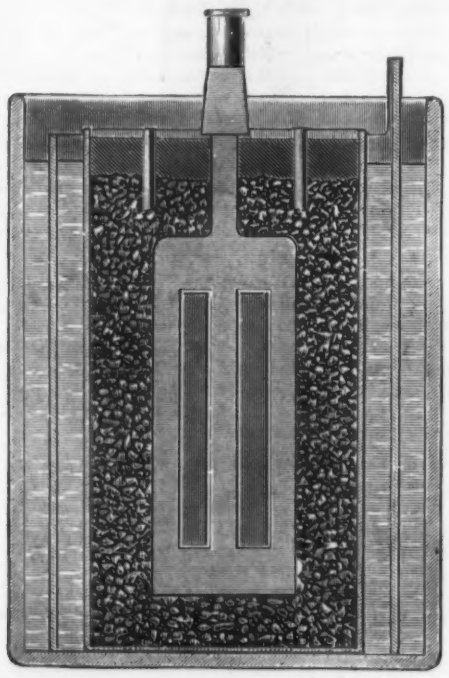


Fig. 2.—MacMillan's Primary Battery.

its walls permit the battery fluid to enter the porous cells through the fabric covering. This latter prevents the carbon from escaping from the porous cells, and also prevents the solid material in the outer cell from entering the porous cup.

The construction and use of the receptacle for the battery materials is shown in Fig. 1. The material of which it is made is cheap and at the same time substantial; its cost is so trifling that after being once used it can be thrown away.

A recent test of this battery made by Mr. George d'Infreville, of this city, shows that the electromotive force of the cell is 1.4 volts, its internal resistance .3 of an ohm, giving 4.77 ampères on short circuit. After being short-circuited for five minutes the electromotive force was 1.2 volts, and after 15 minutes 1 volt. After being allowed to rest for a minute the cell gave 1.1 volts on again closing the circuit. When closed on an exterior circuit having a resistance of 1 ohm and allowed to remain for four hours the cell was found to have about two-thirds of its original voltage. When short circuited for six hours the electromotive force was reduced to .7 of a volt, and the same cell, after resting for 16 hours, had almost entirely recovered its former electromotive force.

Lieb's Electrical Appliances.

One of the most ingenious designers of appliances that are of service in every-day electrical work, some of whose apparatus has been described from time to time in The Electrical World, is Mr. C. A. Lieb, of 17 to 27 Vandewater street, this city. A few of his recent inventions that he is just now perfecting and placing upon the market are illustrated on this page. Fig. 1 shows a terminal connector for electric wires, its use being clearly shown by the illustration. In connectors of this kind now in use, the necessity of soldering the terminal to the wire at what may be called the heel of the terminal has almost always led to a breakage of

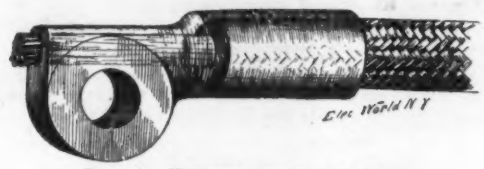


Fig. 1.—Terminal Connector.

the wire at this point, due to the hardening of the copper. This is especially noticeable where terminals of this kind are used in connecting the cables of a street car to the motor which is flexibly suspended underneath the car, the continued vibration very soon breaking the connection. In the terminal here shown it will be seen that the point at which the soldering is done is at the opposite end of the terminal, and any vibration is taken up by the cushion formed by the insulating material of the wire, which, as will be seen, extends into the terminal. These

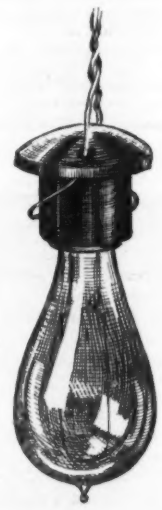


Fig. 2.—Lieb's Lamp Socket Attached to a Lamp.

Fig. 4.—Mica-Covered Wire.

are made in all sizes to suit all numbers of wire and thicknesses of insulation.

Figs. 2 and 3 show a new lamp socket, which Mr. Lieb has just patented and will immediately place upon the market. Its simplicity of construction, its neatness of appearance, its water-proof character and the ease with which it can be manufactured are all very striking features of this new socket. As will be seen, the only metal parts are the threaded core, with a small piece of metal projecting at the point *B*, and a second piece of brass, which comes to the surface of the insulating material at the point *C*, and is also exposed on the interior of the socket, where contact is made at the base of the lamp. These metal parts are held in a die, and insulating material of durable character, which hardens and takes a nice polish, is forced into the die under pressure, and removed after it has cooled and hardened. This is practically the whole process of manufacture of these sockets. The leading wires of the lamp are brought through a pair of holes in the insulating material, as shown in Fig. 2, and attached by small set screws at the points *B* and *C*, Fig. 3, the weight of the lamp being held by a knot in the wire, as shown in Fig. 3. A glance at Fig. 2 will show what a neat appearance the socket has when attached to an ordinary 16 c. p. lamp. It should be mentioned that the socket as shown in Fig. 3 is full size.

Another electrical novelty which Mr. Lieb, in connection with Mr. C. F. Splitdorf, is placing upon the market is shown in Fig. 4. This is nothing less than a mica insulation suitable for all sizes of wire from the smallest used in magnet winding to the largest cable. As shown in Fig. 4, the insulating ribbon consists of three leaves, the two outer ones being of paper, the middle one being a very thin film of mica. The material is prepared in large sheets, then cut into ribbons and afterward wound upon spools exactly as one would wind thread. These spools are placed upon a specially designed machine which wraps the wire with the insulation as quickly as it can be done with cotton thread. Wire covered with this material is afterward covered with any insulating or protecting material that may be deemed

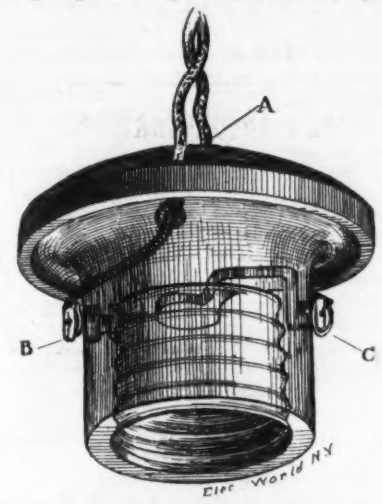


Fig. 3.—Lieb's Lamp Socket (Full Size).

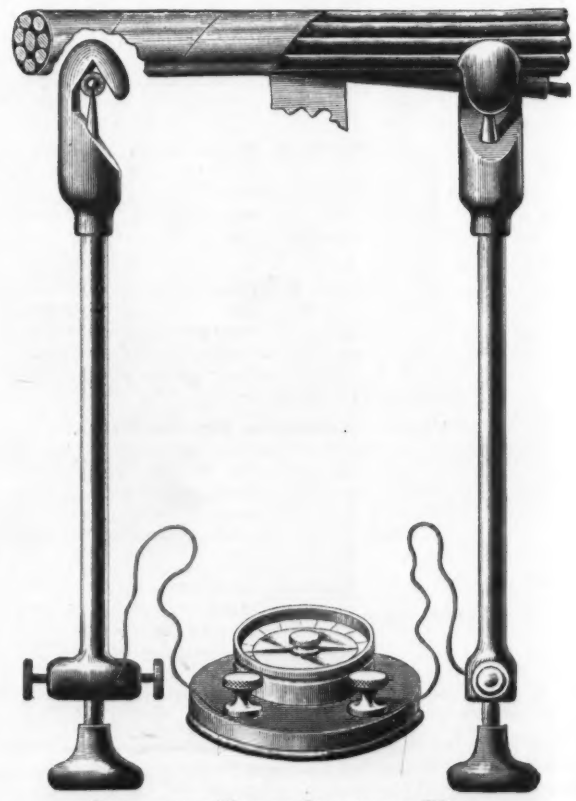
necessary. If the outer covering is made of rubber the mica acts as a very effective protection against the effects of undue heating. Special tests have shown that the wire is admirably adapted for use in the winding of street railway armatures, and several large orders have already been received from a number of the largest street railway companies for trial lots of the wire.

Electric Transmission of Power at Fribourg.

The municipal authorities of Fribourg are about to install a station for the hydro-electric transmission of power at the Sarine dam, outside the town. The contract has been awarded to MM. Cuenod Sautter et Cie., of Geneva, who will install two 150 h. p. 150-volt machines. Distribution will be effected on the three-wire system. The prices which it is proposed to charge are comparatively low. Thus the charge for 1 h. p. during a year of 3,000 hours will be 345 fr. In the case of a 5 h. p. motor, the charge will be 315 fr. per h. p. per annum, and 195 fr. per h. p. per annum for motors of 21 h. p. and upward.

An Ingenious Insulation Piercer.

One might say at first thought that a device for piercing the insulation of wires is precisely what electricians want



Tester for Use on Insulated Wires.

to avoid, but there are many cases in the testing of insulation of various low tension circuits where a wire must be either bared of its insulation or cut outright. To scrape off or cut the covering of a wire means patching it up again afterward. Hence the little instrument shown in our cut, the invention of Mr. Gustave S. Neu, of this city. Its mode of operation is almost self-evident: a push of the sharp plunger of carefully tempered Stubbs steel, a turn of the clamping screw, and all is ready for testing. Even a heavily insulated line wire can be pierced to the core very easily, and the hole left is so minute that a pinch closes it up, while even the smallest sizes of wire are reached without danger of slipping or breaking.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe Street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

TELEPHONE STOCKS.

Chicago	$230@	$240	Cumberland	$60@	$62
Central Union	52@	53	Wisconsin	118@	120
Michigan	83@	84	Bell of Missouri	160@	165
Great Southern	30@	32	Iowa Union	20@	22
Colorado	34@	36	Missouri and Kansas	54@	56
Rocky Mountain Bell.	40@	43			

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95@	$100	Chicago Edison Co	$145@	$150

NEW INCORPORATIONS.

The Virginia City Company, of Portsmouth, Va., has been started with a capital stock of $1,000,000 to run water, electricity and gas works. Its incorporators are J. H. Dingee, S. H. Norris and R. S. Brock.

The Appleton Edison Electric Company, of Appleton, Wis., with a capital stock of $100,000, has been formed to carry on general electrical business. The incorporators of this new company are A. L. Smith, C. A. Beveridge and F. G. Kurtz.

The Poland and Minot Water, Electric Light and Power Company, of Mechanics Falls, Me., has been incorporated with a capital of $25,000. The incorporators are: J. Hanscom, Luther Perkins, A. E. True, N. D. Pope and J. M. Libby.

The Washington-Charlottesville Construction Company, of Charlottesville, Va., with a capital stock of $100,000, has been formed to start water, gas and electric works; mining, building, etc. Its promotors are R. W. Darby, A. S. Johnson and W. Deitz.

The Radford Water, Light and Power Company, of Radford, Va., has been formed with a capital stock of $1,000,000 to prosecute the business of starting water, electricity, gas and steam works, etc. Its promoters are F. J. Kimball, J. I. Doran and J. H. Dingee.

The Riverside Edison Company, of Riverside, Ill., has been incorporated with a capital stock of $40,000, for the purpose of erecting and operating a plant for producing and distributing electric light and power. The promoters are W. W. Hutchinson, Lewis Lusk and M. C. Myers.

The Chicago Electric Manufacturing Company, of Chicago, Ill., with a capital stock of $10,000, has been incorporated to make, use, sell, patent and exploit all kinds of electrical devices appliances and machinery. Its promoters are J. D. Claghorn, H. B. Hallock and C. P. Chapman.

The Fottrell Insulated Wire Company, of Philadelphia, Pa., has been incorporated with a capital stock of $200,000, to manufacture insulated wire and cables, insulating materials and compounds, and electrical appliances. The promoters are John R. White, Charles Barclay and J. B. Colahan, Jr., all of Philadelphia.

The Mount Pleasant Electric Street Railway Company, of Pennsylvania, has recently been formed with a capital stock of $50,000, to operate an electric street railway from Mount Pleasant to Morewood in East Huntingdon, Westmoreland county. W. D. Mullen, T. S. Tintsman and R. H. Goodman are the promoters.

The Ashland and Centralia Electric Railway Company, with a capital stock of $20,000, has been formed for the purpose of constructing an electric street railway from Ashland, Schuylkill county, to Centralia, Columbia county, Pa. The incorporators are John E. Reilley, D. S. Marshall and M. T. Donahoe, all of Ashland, Pa.

The Spring Hill Street Railway Company, of Pennsylvania, has been organized with a capital stock of $12,000 to operate an electric street railway from O'Hara street and Madison avenue, Allegheny, to Reserve township. The incorporators are Dr. Nicholas Schenkel, William C. Haslage and John M. Goehring, all of Allegheny City, Pa.

The Boston and Great Falls (Mont.) Electric Light and Power Company, having its principal office at Jersey City, N. J., has been formed with a capital of $150,000, to manufacture and use electricity for producing light, heat and power, etc., etc. Albert S. Bigelow, Clarence H. Bissell and Charles O. Parsons are its incorporators.

The Youngstown Street Railway Company, of Youngstown, O., was recently incorporated with a capital stock of $500,000 for the purpose of building and operating street railroads by horse, cable, electric or other power, and to furnish power and light, etc. The promoters are W. J. Crawford, Wm. B. Sanders, J. H. Dempsey, Lon M. Snyder and Harrison M. McGraw.

The Norwood Park and Maine Electric Railway Company, of Chicago, Ill., has been incorporated with a capital stock of $250,000, to operate and construct a line of street railway from a point in the village of Des Plaines to a point in Chicago, to be operated by electricity or other motive power. Its incorporators are Freeman J. Short, Martin E. Cole, Russell O. Dunning and Andrew Dunning.

The Lincoln Street Railway Company, of Lincoln, Neb., has been incorporated with a capital stock of $2,000,000 for the purpose of continuing the business of the Lincoln Electric Railway Company and the Lincoln Street Railway Company, the two having been consolidated. Its incorporators are J. D. McFarland, C. J. Ernst, J. W. Dewiese, F. W. Little, Joseph Sampson, T. E. Calvert Henry, of Lincoln, Neb.

The Wabash Avenue Subway Transportation Company, of Chicago, has filed articles of incorporation with the Secretary of State. The capital stock is $10,000,000. A four-track railway is to be constructed under Wabash avenue, Chicago. Electric motors will be used to propel the trains. The incorporators and first board of directors are George W. Cole, Silas Rhodes, J. Warren Pease, Maria E. Beasley and Pleasant Amick.

The Cambridge Light and Power Company has filed a certificate of incorporation in the office of the New York Secretary of State. The object of the company is to generate, use and supply electricity for heat, light and power in the towns of White Creek, Cambridge and Jackson, Washington county, N. Y. The capital stock is $7,000, divided into 70 shares of $100 each. The directors for the first year are Jerome B. Rice, John L. Agar, Andrew B. McNish, William L. Hitchcock, Alonzo D. Frisbie, Eugene R. Weir and Ensign Cop eland, all of Cambridge.

Rochester, N. Y.—The certificate of incorporation of the Kettle Falls Electric Company was filed in the Monroe County Clerk's office July 24. The capital stock is $100,000. The plan is to utilize the Kettle Falls as a motive power from which to generate electricity for lighting and power purposes. The principal office is to be in Rochester, N. Y. The system to be used has not yet been decided upon. The incorporators are T. J. Reynolds, G. H. Smith, A. A. Davis, J. H. Richards, C. H. Briscoe, G. Foster, W. H. Reid, N. M. Collins, Charles Mann, C. E. Sunderlin, C. G. Baglay, J. E. Whitney, E. D. Cook, H. J. Amos and L. M. Grube, all of Rochester.

The West Side Street Railroad Company of Elmira was incorporated July 29 to operate a surface electric road ten miles in length in Elmira. The company is to last 999 years, and the capital stock is $100,000, divided into 1,000 shares of $100 each. The directors for the first year are: B. Harry Carpenter, Wilkesbarre Pa.; Howard H. Hallock, Daniel T. Pratt, Boyd McDowell, Alfred E. Ackley, William H. Barthofl, Charles A. Hurlbut, Fred H. Burgher, and James T. Wise, of Elmira. The East Side Street Railroad Company of Elmira was also incorporated the same day. It is to operate a surface electric railroad five miles in length in Elmira. The directors are the same as the West Side road, and the capital is $50,000. These two roads cover all the main thoroughfares in Elmira, and give the capitalists a practical monopoly of all transportation in that city. The overhead trolley system will be used, but by which company has not yet been determined.

AFFAIRS OF THE COMPANIES.

The Somerville (Mass.) Electric Light Company paid a semi-annual dividend of 3 per cent. Aug. 1.

The Southern New England Telephone Company, at its recent annual meeting, declared a dividend of one per cent.

The United Electric Securities Company announces that it has bought for the sinking fund under the third call $50,000 of its first series collateral trust sinking fund 5 per cent. bonds.

The Electron Manufacturing Company, of Brooklyn, N. Y., has filed a notice with the Secretary of State of an increase of capital stock from $100,000 to $200,000 in shares of $100 each.

The Thomson-Houston Electric Company has declared a quarterly dividend of $1 per share on the common stock, payable Aug. 15 to stockholders of record Aug. 5. The books are closed from Aug. 6 to Aug. 15.

The Great Western Electric Supply Company, of Chicago, has declared a quarterly dividend of 2 per cent on $350,000 of preferred stock. It is said that the company will also pay 6 per cent on the common stock.

The Direct Cable Company's Earnings for the six months ended June 30 last were £37,352, and the expenses £18,112, leaving a balance of £19,240, which, added to the existing surplus, made a total of £24,750 at the end of the period named.

The Hyde Park Electric Light and Power Company, of Chicago, Ill., held a general meeting last week and increased its capital stock from $100,000 to $500,000 to enable it to proceed with the work of improving and increasing the service.

The Pawtucket (R. I.) Cable Tramway Company has changed its title to the Pawtucket Valley Electric Street Railway Company. The general assembly has passed an act enabling the company to run an electric line through the principal streets of the town.

The Tropical American Telephone Company held its annual meeting at Long Branch, N. J., on Wednesday of last week and re-elected the old board of directors. The report showed the company to be in a prosperous condition and doing a satisfactory business. The directors met in Boston and re-elected the old staff of officers.

The Westinghouse President.—A dispatch from Pittsburgh says that Mr. George Westinghouse will be re-elected president of the Westinghouse Company by the new board of directors, although it has been currently reported—as was stated in the last issue of THE ELECTRICAL WORLD—that Charles Francis Adams, one of the new directors, was to be chosen president.

The Stillwater (Minn.) Gas and Electric Light Company, at its recent annual meeting, elected the following officers and directors: Isaac Staples, president; E. L. Hospes, vice-president; R. Davis, secretary and treasurer, and N. M. Johnson, superintendent. The directors are: Isaac Staples, E. L. Hospes, A. T. Jenks, David Tozer, N. M. Johnson, David Bronson and E. W. Durant.

Westinghouse Adjourned Meeting.—The meeting of Westinghouse stockholders at Pittsburgh last week was unimportant. The annual and special meetings have been adjourned for four weeks. Mr. Westinghouse reports everything moving along favorably. The committee has 60 days to perfect the organization and this will be done before the time limit. The old officers will be retained, but changes will be made in financial policy.

The Santa Monica (Cal.) Wharf and Terminal Railway Company, recently formed for the purpose of building an electric road to Inglewood, Cal., to connect with the belt line system, held a meeting recently and elected the following officers and directors: Directors—Elsworth Chaffee, Arthur Gayford, J. A. Stanwood, of Santa Monica, and C. C. Hall and James Campbell, of Los Angeles. Officers—James Campbell was chosen president; J. A. Stanwood, vice-president; Elsworth Chaffee, secretary, and Arthur Gayford, treasurer.

The Thomson European Electric Welding Company has granted the purchasers of the patents for Great Britain until Sept. 1 to pay the balance of £30,000 cash due upon the contract. The company has already received some $320,000. It has also extended the option of the German parties until Sept. 1. Trial machines have been sent to the south of Europe, on which a royalty is received, and there is a prospect of selling the rights for Italy, Spain and France. Besides this, the company has given a license for the use of the projectile patents all over Europe for a royalty on the welds made. It is thought by some that the projectile business will be the best of all the electric welding business in Europe.

Erie Telegraph and Telephone Company.—The executive committee of the Erie Telegraph and Telephone Company has recommended the that usual one per cent. quarterly dividend be declared, payable Aug. 17 to stockholders of record Aug. 8. The directors will meet in New York to declare the dividend Aug. 7. The report for the quarter ending June 30 shows for the Cleveland Telephone Company, Northwestern Telephone Exchange Company and the Southwestern Telegraph and Telephone Company:

	1891.	1890.		
Gross	$208,782	$189,392	Inc.	$19,390
*Expenses	145,713	127,949	Inc.	17,764
Balance	$63,069	$61,443	Inc.	$1,626
†Dividends	$48,000	$48,000		
Surplus	15,069	13,443	Inc.	1,626
Subscribers added	163	417	Dec.	254
Total subscribers	13,539	12,662	Inc.	877

*Includes dividends on Bell company's stock. †Includes in 1891 $10,782 surplus of sub-company's portion of which belongs to the Bell company, and in 1890 $9,843.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
166-177 TIMES BUILDING, NEW YORK, Aug. 3, 1891.

Strike on the Newark (N. J.) Electric Line.—When the Newark Passenger Railway Company took possession of the Rapid Transit Electric Line, recently, trouble was predicted. The trouble came last week when eighty motor men and conductors quit work and refused to take out the cars. The men met quietly and decided that they would run one trip in order to take the patrons of the road to their work and then quit, a programme they carried out. The men were receiving $1.80 per day for eight trips. The men now demand $2 per day for seven trips and less time on swings. A committee was appointed to wait upon President Ban, of the Newark, and lay their demands before him.

Dinner of the Magnetic Club.—On Wednesday of last week the Magnetic Club of this city held its annual dinner at Fort Wadsworth, on Staten Island. About 75 persons were present and sat down to the dinner of the club. Through the kindness of Superintendent Humstone, of the Western Union office in this city, that company's cable boat was placed at the disposal of the club for the afternoon, and at about four o'clock it was boarded by all who could leave their business at that early hour, and a very enjoyable sail was taken down the bay to within a few miles of Sandy Hook. Such members of the club as cared to indulge in a game of base ball were landed on Staten Island while the remainder of the party took the bay trip. Erastus Wiman was the guest of the club, and made a very entertaining after-dinner speech; toasts were responded to by Ed. Delany, Thos. P. Scully, E. E. Brennin, Judge Greene, A. L. Eugene and E. M. Tomlinson. The party was very agreeably entertained by vocal and instrumental music furnished by Prof. J. Gschwind and Mr. D. W. McAneeny. A vote was given to Mr. Humstone for his kindness in giving the club the use of the Western Union Company's cable boat for the afternoon. It was not far from midnight when the boat, with its 75 telegraphers, returned to New York City.

L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Aug. 1, 1891.

Mr. J. F. Shawhal, of the Shawhal Electrical Works, of Concord, N. H., was in town Friday.

The Worcester, Leicester and Spencer Electric Railway will open from Worcester to Leicester, Mass., early this month.

Messrs. C. S. Knowles & Co. have taken the New England agency for R. Thomas & Son's Porcelain Works at East Liverpool, O.

Eastern Electric Supply Company.—James A. Middleton manager of the railway department, starts on his semi-annual trip through the Middle and Western States this week.

Lynn, Mass.—The report that the Lynn & Boston Railroad Company was to build an electric line from Lynn to the Point of Pines is now said to have been untrue. President Breed of that company says he knows nothing of the project.

Mr. E. B. Crocker and Mr. Fred Angell, of the Electrical Specialty Company, of Pawtucket, R. I., were in town on business this week. It is understood that the Eastern Electrical Supply Company will act as New England agent for them.

Missing.—Stephen E. Barton, President of the Electric Mutua Insurance Company, 85 Water street, Boston, when last seen was departing for the South with his three-barreled gun. His friends are afraid that the authorities of Georgia have captured him and that he is now serving out his sentence.

Holyoke, Mass.—The work on the electric street railway is progressing satisfactorily and the officials expect to have the road ready for the trial trip about the middle of this month. The over head wires have all been strung and the ground wires are all laid with the exception of those under the canal bridge.

The Thomson-Houston Company has in its shops at Lynn a complete system of telephony, consisting of a central office and fifty instruments connecting the different departments, and also the outside or public lines, so that any department can be connected to communicate with Boston, New York, etc.

The Bradbury-Stone Storage Battery Company, of Lowell. Mass., has recently installed a 115-light storage plant for Messrs. Cutler Bros. through the Thomson-Houston Company for the electric lighting department of their building. The plant consists of 96 cells of batteries in connection with a Thomson-Houston generator.

The Annual Clambake.—The thirteenth annual Rhode Island clam dinner tendered to the electrical fraternity by the American Electrical Works, of Providence, R. I., is to be given at the Vue de l'Eau Club on Saturday, Aug. 8. The invitations sent out by the members announce a lunch at 11:30. The Reception Committee is composed of M. J. Perry, Providence; H. B. Cram, Boston; John I. Sabin, San Francisco; C. P. Huntley, Buffalo; E. B. Baker, New Haven, and W. H. Sawyer, Providence.

Hartford, Conn.—The new building of the Pratt & Whitney Company on Capitol avenue was a scene of festivity last Tuesday night. The occasion was its formal dedication, with a band concert from 8 to 9 o'clock and a sociable following. The building has been erected for the use of the extensive small tool department of the factory, the employés of which, nearly 100 in number, by permission of the officers of the company, celebrated the completion of the building by giving the entertainment, which proved a perfect success.

Dr. Mason, the active general manager of the Simplex Electrical Company, has almost completely recovered from the sickness which caused his trip to Jamaica, and is now as ready as ever to explain to those new in the field the merits of "Simplex" insulation; but the Doctor adds that nowadays almost everybody recognizes its merits, and that duplicates of orders are very frequent. Your correspondent has from time to time been aware that the goods of this company were being rapidly introduced all over the world, and was therefore not surprised to be shown an order for 30 miles of wire which is now on its way to Demerara.

C. A. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Aug. 1, 1891.

Middletown, Del., is agitating the idea of an electric railway.

Mr. S. F. Betts, of Wilmington, Del., is manufacturing a motor which is giving satisfaction wherever used. A large number are in use in Wilmington.

The Electro-Dynamic Co mpany is running a large force of men, some 140 being employed. Their shops contain a fine lot of machinery and the company is able to turn out the heaviest kind of work.

Messrs. Walker & Kepler have over a dozen large contracts on hand, and employ a great many hands. Some of their largest recent contracts are: The Empire Theatre, Hotel Metropole, J. E. Caldwell & Co.'s large jewelry store, and the Drexel School.

The New Betz Building, the 13-story structure which is going up on the site of the old Western Union office, Broad and South Penn square, is to be fitted up with the finest and most complete electric plant to be had. Dr. W. A. Drysdale will have the supervision of the work. He is also superintending the electrical work in the Empire Theatre.

The Wilmington City Electric Company has a very complete plant consisting of one 200 and five 100 h. p. Armington and Sims engines, driving two No. 12, four No. 20 and two No. 32 Edison, two 750-light Westinghouse and two 75-light Ball arc dynamos. Besides furnishing light to the city outskirts, the company has many private consumers both for light and power, and is running nearly up to full capacity. The Wilmington company furnishes power for over 100 motors ranging from ⅛ to 15 h. p. They report business as very satisfactory and prospects good for the rest of the year.

The Wilmington City Railway Company's business has greatly increased since the introduction of the electric cars, and the company is making every preparation to keep up with the increased traffic, by enlarging its plant and putting on new cars. The plant at present consists of three 100 h. p. boilers, three 150 and one 50 h. p. Westinghouse engines, which drive six No. 20 Edison generators and one No. 10 dynamo. In a week or two the plant will be increased by the addition of three 100 h. p. boilers, a 250 h. p. engine and two No. 32 generators, when the company will also put on 13 new cars with the Westinghouse single-reduction motor. A new car shed 220 × 69 is being built by the Berlin Iron Bridge Works. Everything about the place shows a skillful supervision. The boiler and engine rooms are as clean as a parlor.

Wm. H. Weston & Co. are very busy filling orders for their switches. Business has increased greatly the past three months, and the outlook for a good year's business is very bright. They have lately put in three new machines and a large motor, and are working at night to catch up with their orders. Among their latest sales are: 87 switches for the Electric Construction and Supply Company, New York, 32 of which were handsomely polished 100-ampère size for a switchboard for H. B. Claflin Company; 55 for Walker & Kepler, Philadelphia, in double and triple pole styles, ranging from 50 to 500 ampères; 50 for the Jenkintown Light Company; a handsome switchboard with seven polished switches mounted for the steamer "Chicago," and various orders for the Novelty Electric Company, F. P. Little & Co., Buffalo, N. Y., and the Keystone Electric Company, of Erie, Pa.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Aug. 1, 1891.

Dr. W. L. Allen, of Davenport, Ia., stopped at the Grand Pacific Hotel this week.

Mr. Herman Andrae, of Milwaukee, Wis., was a welcome visitor in Chicago this week.

Mr. A. E. Partridge, of Chehalis, Wash., was among the visitors in Chicago this week.

Mr. T. T. Eckert, Jr., is visiting friends in Chicago, while en route from the West to his home in New York.

Mr. C. R. Vincent, secretary of the Ball and Wood Company, of New York City, has been visiting the Western cities during the past 10 days.

Mr. Herbert Wadsworth, The Rookery, Chicago, has secured the contract for placing Excelsior arc and incandescent apparatus in "The Bee Hive," on State street.

Mr. George H. Meeker has returned to his desk at 78, 80 and 82 Franklin Street, Chicago, after a three weeks illness, and is again pushing the interests of Grimshaw wire.

Mr. Lemuel S. Boggs, who until recently was doing research work at Purdue University, is now connected with the Sperry Electric Mining Machine Company, Chicago.

Mr. E. W. Long, formerly connected with the United States Electric Lighting Company, has been appointed superintendent of the extensive light and power plant of the Ironwood Electric Company, at Ironwood, Mich.

A Sign of the Times.—The Electrical Supply Company, 102 and 104 Michigan avenue, Chicago, has placed an open wire sign on the top of its building, the lettering of which is clearly defined against the sky at the distance of a mile or more.

Mr. H. M. Underwood, of the Interior Conduit and Insulation Company, is returning to New York, having turned over the agency to the Electrical Engineering Company. During his stay in Chicago Mr. Underwood has made many friends who wish him success wherever he goes.

Mr. George L. Kirkham, manager of the Northwestern Electric Specialty Company, of Chicago, Ill., is to be congratulated on the addition to his staff of "hustlers," the youngster having reported for duty on Tuesday and immediately started operations by filling his lungs preparatory to yelling for the Economic lamp.

Topeka, Kan.—The Board of Public Works has received a statement of the cost of electric lights for the past two years from the City Electrician. From November, 1889, to June, 1891, the highest cost for arc lamp circuits was $8.14 per light per month, and the lowest cost was $5.38 per month, thus making the average cost per lamp about $7 per month.

Mr. Charles H. Summers, electrician-in-chief of the Western Union Telegraph Company, has returned to Chicago from an extended trip to the Pacific Coast. His son Bert Summers was paid the unusual honor during this week of being mentioned in general orders read at the parade of the United States troops at Fort Sheridan, for his efforts in assisting to rescue some soldiers from drowning.

The Ampere Circle, composed of employés of the Duluth Municipal Street Railway Company, with Mr. F. S. Ward, of the company, as chairman, held its regular monthly meeting at the office of the company last week. There was a large attendance and an excellent paper was read by Chief Engineer Brinkelson, entitled "Application of Electricity as a Motive Power Compared with Steam." A pleasant feature of the occasion was the refreshments served by Mr. Ward, superintendent of the company.

Amateur electricians held a meeting at Chief Barrett's quarters last week and effected a preliminary organization with a view to giving a great exhibit of amateur work in the electricity department of the World Fair. O. E. Cozzens was made chairman and J. F. Connor secretary. Committees on organization and rules were appointed, and will report at a meeting to be called next week. Secretary Hornsby, of the department of electricity, explained that the amateurs are to have space and classification for their exhibits. Medals will be awarded and competitions decided in the same way as in the professional exhibits.

Milwaukee, Wis.—At the council meeting last week the Badger Electric Light Company met with another defeat in the adoption of an amendment to the ordinance ordering all electric light wires under ground. The original ordinance, which prohibited the erection of any more poles after its adoption, was so changed as to extend the term until 1892, which enabled its rival, the Milwaukee Power and Lighting Company, to bid for the lighting, equip its lines and then place its wires in subways within five years thereafter. This will place the new company on an equal footing with the Badgercompany.

The Elston Line Joins the "L."—It is reported that the Grand Avenue Electric Railway Company and the Elston Road Electric Railway have made connection with the Lake street "L" road and will enter the city over the tracks of the latter company. Although the truth of this report is denied by the officials of both roads, there is every reason to believe that negotiations between the two companies are now under way with every prospect of a successful culmination. The Grand Avenue Electric has secured its right of way on Grand avenue to Western avenue and on Western avenue south to Fulton street, but it cannot get the right of way east on Fulton. The same is true of the Elston avenue electric road, and both of them would undoubtedly be willing to make an arrangement with the Lake street people whereby they could land their passengers in the business centre, and the Lake street road would find the electric lines good feeders, as they would develop a very valuable tract of land.

The Villard Syndicate.—Another deal in pursuance of the work of placing all of the street railway lines and electric lighting facilities of the city under the control of the Villard syndicate was consummated in Milwaukee last week. The Villard people had previously secured possession of the Milwaukee City and Cream City lines, and there is better than surmise for confidence that the reported negotiation of a loan of $1,000,000 to the West Side or Becker Line was the consideration for a controlling interest in that company. A meeting was held and the Milwaukee City Company, which is still operated under a distinct management, was consolidated with its most dangerous rival, known as the Pfister company, which owns the dummy steam railway to Whitefish Bay and franchises of great value in the city, which permitted not only a paralleling of the Milwaukee road in important districts, but which give exclusive rights in new and rich territory which would support feeders to either system. There were present at the last meeting, representing the Villard interests, D. S. Wegg, of Chicago, and Henry C. Payne, of Milwaukee, and representing the home company Charles Pfister and Richard Burke. F. de L.

Kansas City, Mo., July 30, 1891.

Mr. J. W. Mason made a flying trip to Chicago last week.

Mr. C. S. Rusling, of the Thomson-Houston Electric Company, came down from Chicago yesterday.

Mr. T. W. Hine, president of the Phœnix Electric Light Company, of Phœnix, Ariz., was a welcome caller last week.

Mr. J. W. Emerson, president of the Emerson Electric Manufacturing Company, of St. Louis, was here last week.

Mr. H. S. Meacham, general Western agent of the Buckeye Electric Company, with headquarters in this city, is making a business trip to the Pacific slope.

The Franklin Electric Company has secured the agency for "Simplex" wires and cables and is already securing large orders. This firm is putting in large quantities of waterproof sockets for incandescent lamps.

Mr. Thos. Wolfe, general southwestern agent of the National Electric Manufacturing Company, is now cosily quartered at 515 Main street. He is enthusiastic over the transformer system and is doing a rushing business.

Mayor Holmes has signed the ordinance reducing electric light charges from $200 per year to $100. Instructions have been issued by the Board of Public Works to terminate all contracts now in existence Aug. 1. The electric light companies have taken no action as yet, but announce that it takes two to make a bargain.

The American Electric Light Company has lately removed its power house from Twentieth and Central to about Twenty-fifth and State line and now has a model plant. The station now consists of ten arc dynamos, Wood system, and one incandescent Heisler system, driven by two compound engines of 250 h. p. each The Wood dynamos are the only ones in use here and are giving satisfaction. The company has recently put in a Thomson static voltmeter and also a Siemens dynamometer registering from 2 to 4,000 ampères. H. D. E.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Dewey's Electrical Refrigerating System.—In your answer to the query of J. E. G., in The Electrical World of June 27, you mention Dewey's system of refrigerating. Please inform me where I can find a description of this system? What is the Thomson effect? W. P. R.

We would refer you to U. S. Patent No. 413,136, of Oct. 15, 1889.

Tesla Motors.—What is the approximate efficiency of alternating current motors of the Tesla type; that is to say, those in which a rotation of magnetic poles is caused by two currents of different phase? What is the relative efficiency of large and small motors of this type? A. W. S.

An efficiency of rather more than 80 per cent. has been obtained. It would be difficult to give figures for the "relative efficiency of large and small motors" of this type, because the factors of inefficiency which might be found alone in the small types may or may not be due to the design, or limits of design.

Storage Cells.—(1) Can I use wood for separating the plates of a storage cell? (2) I have six cells of gravity battery and two storage cells. What is the best way to connect them up for working? (3) How can I prevent the acid from attacking the connections? Subscriber.

(1) Wood unless thoroughly soaked with wax or paraffine is not good material for separating the plates; rubber is better. (2) Connect your storage batteries in parallel and in charging them use the gravity cells in series. (3) Keep your connections out of the acid, and paraffine them to protect from fumes and spattering.

Dynamo Capacity.—Will you please tell me how to find the number of lights a dynamo will carry if the internal resistance, electromotive force and data for the lamp are given? J. A.

We presume you refer to incandescent dynamos. The capacity depends on the carrying capacity of the armature wire; with most machines a safe allowance in the armature is 500 square mils of cross-section per ampère. You must remember that the two halves of the armature from brush to brush are in parallel, so the carrying capacity will be double that of the size of wire used in winding the armature. You can thus determine the permissible ampèrage from the size of the armature conductor, and if you know the data of your lamp you have all the necessary information.

Capacity of Railway Generators.—I am running a 500-volt 70-ampère dynamo for street railway work. It does the work easily during the week, but on Sunday is hardly able to accomplish it for a few hours when the number of passengers is large. How much more voltage could I get with safety for these few hours? J. M. C.

You can probably run 550 volts very well, and we should not hesitate to put the voltage up a little higher even than this if necessary. It is better, however, to get another machine when the load proves too much for one, as you have the additional advantage of security against serious breakdowns.

Wheatstone Bridge Measurements.—Kindly inform me through The Electrical World how to calculate exactly a resistance when using a Wheatstone bridge; for instance, as in the following case: When .1 ohm is plugged the galvanometer deflects two degrees to the left, and when .2 ohm is plugged the galvanometer deflects nine degrees to the right. What resistance will bring the needle to zero? J. A. L.

Approximately .12 ohm. A more accurate method, however, than to plug in the above resistance is to place between the "infinity" terminals a piece of german silver wire of uniform diameter and known resistance, the length of which is variable. Now change the length of the wire between the terminals until the needle is brought to zero, and then calculate the exact resistance of the wire from the length of german silver between the contact points.

Relation between Electrical and Mechanical Units.—(1) Is there any exact relation between the mechanical and electrical horse power? If so, what is it? (2) In an incandescent plant with 110-volt dynamos, five per cent. loss of lamps, should the dynamo be run at 110 or 115½ volts? (3) Will a difference of five volts make any perceptible difference in the illuminating power of a 110-volt incandescent lamp? Impractical.

There is an exact relation, one mechanical horse power being equal to 746 watts. We would suggest that you might read with profit Prof. Kimball's articles on electrical units in The Electrical World, beginning with the issue of Jan. 17, 1891. (2) Run your dynamo so as to give at the lamps the voltage for which they are marked. (3) Yes. The difference in light would be something like a candle per volt.

Fatal Pressures.—I fail to understand how a person can receive with safety a shock from an induction coil of say 50,000 volts, and yet meet with fatal result from a shock taken from the terminals of a dynamo having the pressure of 1,000 volts. Will you enlighten me upon the subject? Albright.

It is not directly the pressure which is fatal, but the amount of current which flows through the body, and the strength of current flow is dependent upon both the electromotive force and the resistance of the complete circuit. Therefore, in the case of an induction coil shock a person places himself in circuit with the enormously high *internal resistance of the coil* and receives through his body but a small current, as even the high difference of potential of say 50,000 volts is unable to cause a large flow through a circuit of such high resistance. In the case of the dynamo the internal resistance is extremely low, thus facilitating a comparatively heavy flow of current through the body.

Arc Light Formula.—I wish to know the relation between the energy expended in an arc lamp and the candle power. Suppose we take a lamp requiring 50 volts and 10 ampères to give X candle power, what amount of energy will it require to produce $\frac{X}{3}$ candle-power, are the watts expended directly proportional to the candle power? Tischendorff's arc light formula for candle power is:

$L=100\left(C+\left(\frac{C}{4}\right)^2\right)-200$, where L represents the candle power and C the current. It does not appear to work out correctly. T. F. C.

(1) There is no direct relation between the watts consumed and the candle power in an arc lamp, and none of the formulæ as yet proposed work out with great accuracy. For example, a 50-volt, 10-ampère lamp gives a certain amount of light; if it is burned at 70 volts and 10 ampères you will have a long, flaring arc of very inferior luminosity.

Electricity vs. Steam.—(1) Is the production of power by electricity less wasteful than the production of power by steam—that is to say, is the ratio of the units of force and the material consumed from which the force is derived to the units of force and work performed greater in the one case than in the other? (2) Does there not appear everywhere a singular wastefulness of force compared with useful results? D.

(1) A considerably greater proportion of the theoretical energy of the material consumed can be obtained from a good primary battery than from a steam engine; but this should be distinctly understood as having no influence whatever on the relative economy of the two, for the good reason that zinc, the material generally used in batteries, is so enormously more expensive than coal. As a pure matter of efficiency the battery is superior to the engine; in cost per unit of power produced it is almost immeasurably inferior. (2) Yes. When energy is converted from one form into another there is, as a rule, constant loss all along the line of transformation.

News of the Week.

THE TELEGRAPH.

New Orleans, La., and Nashville, Tenn.—The Postal Telegraph Cable Company has at last completed its lines from Nashville to New Orleans.

Postal Company Extensions.—The Postal Telegraph Company has opened new offices at Hammond, Roulette, Port Allegany, Minards, Sweden Valley and Coudersport, Pa., as well as Corning, Addison and Canisteo, N. Y.

The Postal Telegraph Company is engaged in repairing its line between Baltimore and Philadelphia. A gang of men started last week from the former place and are working this way as rapidly as possible. New poles have been put in where needed and the wires straightened.

Washington, D. C.—Second Comptroller Gilkeson has approved bills of the Western Union Telegraph Company, amounting to $105,603, for telegraphic service for the United States Signal Bureau, at the rates established by the Postmaster-General. The company has notified the Secretary of the Treasury that it will accept payment at the rates named, under protest, until the question of the legality of the present rates can be judicially determined.

Minneapolis, Minn.—A party of distinguished officials of the Western Union Telegraph Company reached Minneapolis last week, having been for the last three months on a tour in the far West inspecting among other places the company's service in California. The party consists of Robert C. Clowry, of Chicago, vice-president and general superintendent of the Western Union lines west of Pennsylvania; C. H. Sommers, electrical engineer, of Chicago; M. C. Bristol, of Chicago, superintendent of construction; and T. T. Eckert, Jr., of New York, son of the general manager of the Western Union.

THE TELEPHONE.

Peoria, Ill.—The Central Telephone Union expects to spend $20,000 in local telephone system improvements.

The New York & New Jersey Telephone Company, which is indebted to Jersey City for various favors, is engaged in rebuilding the city fire-signal and telephone circuits. The entire work is to be finished within three weeks.

The New England Telephone and Telegraph Company has issued a new list of subscribers, which shows a very large increase in business for the preceding year. Amlost everywhere metallic lines are used, and the old style of instruments in is almost every case replaced.

THE ELECTRIC LIGHT.

West Bend, Wis., is to be lighted by electric light.

Cannelton, Ind., has contracted for an electric light plant.

Pittsburgh, Pa.—The Edison company's bid for furnishing the electric light fixtures for the new post office has been accepted.

Grand Plains, Cal.—Mr. John W. Hearst has applied for an electric street railway franchise and proposes to install an extensive tramway system.

Altoona, Pa., has received a bid from a prominent citizen to illuminate the town for $1,200 a year less than the Johnstown Electric Light Company.

Leavenworth, Kan.—The Merchants' Electric Light Company has applied for a franchise, and will build an electric light plant at once if the charter is obtained.

Grand Rapids, Mich.—After a lengthy discussion last week the council decided by an almost unanimous vote on the tower system for the city electric lights. The new system must be ready within 90 days.

Denver, Col.—The city electric light contract has finally been signed, the authorities agreeing to pay $12.50 instead of $14.50 per month for arc lights. By this reduction, a saving of $9,600 during the term of the franchise, which expires in 1898, is effected.

Great Falls, Mont.—The Queen of the Hills Mining Company, at Neihart, has closed a contract with the Thomson-Houston company for complete electrical outfit for working the mine. The plant is to be completed by Oct. 1. The cost is to be about $50,000.

Marshall, Ind.—A contract for 10 years has been made with the Western Electric Company, of Chicago, to supply the city with 30 arc lights of 2,000 c. p. each at $75 a year per light. The same company is to furnish an incandescent system for commercial and residence lighting.

The California Electric Light Company has been absorbed by the Edison Light and Power Company, which was incorporated a short time ago with a capital stock of $3,000,000, the consideration of the transfer being $1,000,000 of the new stock. It is stated that the central station for the new plant will be constructed at once at a cost of $300,000, and that the wires will be placed underground.

Detroit, Mich.—It is said that some time ago the agents of the Jenney Electric Light Company, of Fort Wayne, Ind., secured the Edison plant at Detroit, paying $1,000,000, and under the name of the Peninsular Electric Light Company went on doing business. The same company has now secured control of the Detroit Brush Company, and will consolidate it with the Peninsular company. The price paid for the Brush company is said to have been $1,100,000.

THE ELECTRIC RAILWAY.

Laramie, Wyo., is to have an electric street railway.

Baltimore, Md.—The North Avenue Electric Railway Company has decided to adopt the Baxter motor system.

Bellevue, Pa.—Mr. Burgess Johnstown has recently sent out notices calling for a mass meeting of the citizens to promote interest in a projected electric railway.

The New York State Railroad Commissioners have granted permission to the Syracuse Consolidated Street Railway Company to change its motive power from horses to the overhead trolley system.

Coney Island, N. Y.—The electric road running from Brooklyn to the beach suffered much damage in the recent storm. All traffic was stopped. New wires and insulators are being put up as rapidly as possible.

Matteawan, N. Y.—The trustees of the village of Matteawan have granted a franchise to the Electric Street Railway Company free of any tax. The trustees have control of switches, kind of rail, etc. Work will soon be commenced.

A New Westinghouse Railway Contract.—The Lake Quinsigamond line of the Consolidated Street Railway of Worcester is to be equipped with Westinghouse single reduction gear motors. Three cars will be fitted out at first and later the entire system will be equipped. The contract was obtained by Mr. R. S. Brown, the New England agent of the Westinghouse street railway department.

Mr. H. L. Pierce, of the firm of Pierce Brothers & Company, electric railway supply manufacturers, of Leominster, Mass., went to Austin, Tex., last week for the purpose of equipping with the electric system the Austin City Street Railway. The firm of which Mr. Pierce is a member is also building the Worcester Consolidated Street Railway and the Worcester, Liecester & Spencer Street Railway.

An Electric Railway for Brazil.—A contract for the first electric railway to be installed in Brazil has been taken by Benjamin Blum, who will send a sample installation consisting of one car with 25 h. p. motors, one 50,000-watt generator and all station apparatus and entire equipment for one and one-half miles track. This is for a narrow gauge road and if successful the entire road (consisting of 60 cars) is to be equipped by Mr. Blum.

Dubuque's Storage Battery Railway, described in THE ELECTRICAL WORLD of July 25, has awakened considerable interest among street railway officials, one of whom mentioned his repeated trips over the line and his surprise that double reduction motors should be so noiseless, though that is probably explained by the fact that they are new and run in oil, though it is well known that the Edco gearing is worked out to show a loss of under 15 per cent. and that the box contains a filtering device so that only pure dynamo oil free from dust and sediment reaches the gear teeth. The ample protection afforded all parts of the machinery by the iron casing was favorably commented on as well as the slight amount of heat in the field magnets, although the car was in constant operation for 16 hours, and currents of air could not pass freely between fields and armature owing to this iron casing. The Gramme armature is insulated with mica, the commutator is of pure copper, and the internal resistance of the motor is but one-tenth of an ohm, making its electrical efficiency 96 per cent.

Electric Railways in Detroit.—As was stated in the last issue of THE ELECTRICAL WORLD, a consolidation of all the street railway companies operating in Detroit, Mich., has been effected, and it is now stated on good authority that the managers of the Detroit Electrical Works constitute the majority of the syndicate controlling the new consolidated system. This, of course, insures the adoption of the Raye motor on all of the lines changed from horse to electric power. The only electric line in Detroit to-day is using the Raye motor.

LEGAL NOTES.

Magnolia Metal Litigation.—The Magnolia Anti-Friction Metal Company, of 74 Cortlandt street, New York City, has issued to the trade an explanatory circular in which a detailed statement is given of the litigation between that company and various employés and agents who have sought for over four years to defraud the company of its business and to establish a trade in another article manufactured for that purpose under the direction of Samuel Singley, an employee well acquainted with the constituents and method of manufacture of the Magnolia metal. The suit brought against these parties was tried in February, 1891, before Judge Pryor of the New York Supreme Court and resulted in a judgment in favor of the Magnolia Anti-Friction Metal Company.

Important Patent Decision as to Re-issue and Validity.—The United States Circuit Court for the Northern District of Illinois held, in the recent case of the Alaska Refrigerator Company vs. The Wisconsin Refrigerator Company et al., that in order to defeat a patent for a combination it is not enough to show that all the elements of the combination, separately considered, were old at the date of the invention; that a re-issue cannot be held invalid because of enlargement of claims when the original patent is not in the case and no evidence is offered to show expansion in the re-issue beyond what is justified by the original specification and drawings, and that the presumption is in favor of the validity of a re-issue applied for and obtained in less than two years after issue of the original patent.

PERSONALS.

Mr. P. C. Burns, of the Peru Electric Manufacturing Company, of Peru, Ind., was in Boston this week and took away a large number of orders.

Mr. D. C. Jackson, electrical engineer in charge of the central district of the Edison General Electric Company, with headquarters at Chicago, has accepted an appointment to the chair of electrical engineering in the University of Wisconsin.

Mr. D. Thomson, of Hamilton, Canada, has accepted the position of general manager of the Hamilton Light and Power Company, limited. He was formerly connected with the Royal Electric Company, of Montreal, as superintendent of the light and power department.

Mr. W. M. Mordey, the well known English electrician, most familiar to American engineers as an expert on alternating currents, was a welcome visitor at the office of THE ELECTRICAL WORLD this week. He will pass a couple of weeks in this country more for pleasure than business, but will try to take a look meanwhile at what we are doing in electrical traction.

MISCELLANEOUS NOTES.

Anti-Magnetic Alloys for Watches.—The following names have been given to alloys suitable for manufacture of anti-magnetic watches: (1) Mangor, an alloy of manganese and gold; (2), volfor, an alloy of wolfram and gold; (3) woltine, a gold platinum alloy; (4) cadmine, a hard and very elastic cadmium compound; (5) aror, an alloy of gold, cadmium and manganese; (6) manium, an alloy of manganese, platinum, bismuth and copper.

Electrical Fly Paper.—A certain storekeeper in Richmond, Ind., with some knowledge of electricity and considerable ingenuity in getting up window attractions, recently constructed an electrical fly-catcher that is unique. It consists of a small induction coil, giving about a quarter-inch spark, with a couple of cells of battery and a series of fine wires strung on a board, very much as in the musical instrument called the zither. Each alternate wire is connected to a terminal of the coil, and the sliding regulator so adjusted that the spark will not quite strike across between wires until an unlucky fly alights on one wire, when the projecting body receives a spark, and the victim takes a header between the wires and leaves the field clear for the next comer.

Industrial and Trade Notes.

The Redding Electric Company is busy installing its celebrated watchman's clocks. The new Hyer-Sheehan motor of this company has been received with much favor.

Mr. Frederic A. Duggan is the proprietor of the Imperial Porcelain Works, of Trenton, N. J., a notice of which was given last week, and not Frederic A. Huggan, as was given through a typographical error.

The Columbia Incandescent Lamp Company, of 1912 Olive street, St. Louis, Mo., is meeting with good success in introducing the Schaefer ceiling cut-out, which possesses advantages over many now in use.

The Redding Electric Company, of 41 Federal street, Boston, is now selling from 30 to 50 electric gongs a week. This is one of this company's specialties, in which it excels. The "Redding" fire gongs are now used in most of the principal hotels in Boston.

Paint for Central Stations.—The Joseph Dixon Crucible Company, of Jersey City, N. J., has issued a little circular giving "A Few Words About Painting," in which some very sensible advice is given about the use of paints for interior use, especially in regard to its durability and lasting qualities.

The Hercules Electric Company, of 22 Custom House Place, Chicago, will shortly place an entirely new type of primary battery on the market. The officers of the company are: H. H. Glidden, president; J. H. Reid, general manager; C. N. Souther, secretary; W. J. Garvey, treasurer.

The Eclipse Clutch Company, of Beloit, Wis., is placing the clutches and shafting in position in the street railway plants in Seattle, and in Omaha, Wash., in the extensive shops of the Holyoke Machine Company, Worcester, Mass., and a long rope drive in the Laclede gas light plant in St. Louis, Mo.

The Law Telephone Company, of 85 John street, New York City, has issued a little pamphlet describing its double-cylinder battery and its application in electro-medical outfits. The pamphlet also contains descriptions of the Bailey current regulator, the milliampère meter, and the induction coil also used in the physician's outfit, put up by this company.

The New York Insulated Wire Company, sole manufacturers of "Vulca" electrical wire ducts, cut-outs, joints, distributing boxes, junction boxes, elbows, etc., etc., has issued a neat pamphlet descriptive of its conduit wiring system. The book contains many clear and handsome cuts, and shows in a decided manner the advantages of the "Vulca" system.

The Eastern Electrical Supply Company, of 65 Oliver street, Boston, is doing more business at present than ever before. Starting one year ago, the company's business has increased with amazing rapidity, considering the competition now in the field. This is no doubt due in a great measure to the active interest and indefatigable efforts of Mr. Brown, its president. Mr. Brown is to be congratulated upon the efficient office force of the Eastern company.

The National Electric Manufacturing Company, of Eau Claire, Wis., has lately sold through the Germania Electric Company, of Boston, Mass., a large number of its well-known transformers for use in New England. The Germania company has sold about 1,600 lamps in New England alone during the past month and 7,000 to the National company, of Eau Clair. This, the company says, is less than usual, but the prospect for a large fall trade is very bright.

The Fort Wayne Electric Company, manufacturer of the Wood arc and Slattery induction systems of arc and incandescent lighting, has issued a very handsome pamphlet containing facsimiles of letters written by users of these systems testifying to their merits. The copy of the pamphlet in question has been sent to us by Mr. W. J. Morrison, general agent for New York State and Canada. It contains upward of 50 fac-similes of letters, all of which speak very highly of the company's systems, which are now in use in a great number of plants throughout the country.

The Bryant Electric Company, of Bridgeport, Conn., has in a quiet way been doing considerable business in the manufacture and sale of switches and sockets for electric lighting systems. During the last few months the sales of this enterprising company are said to have far exceeded the most sanguine expectations of its managers. The sockets put upon the market by the Bryant company are made for all styles of lamps and all make use of porcelain insulation. The Central Electric company, of Chicago, has recently been added to the list of the Bryant Company's agents, and will in the future control the Western trade for these electrical appliances.

The Electric Gas Lighting Company, of 195 Devonshire street, Boston, Mass., has been doing a very large business of late, owing to the many excellent additions recently made to its stock, and to the careful management of the firm during the last year. This company, jointly with a single other house, owns the patents on one of the best systems of electric gas lighting extant. The "Victor" electric bell is now in great demand, and the well-known "Samson" battery cell still stands the test of time, the company now being 3,000 orders for the latter cell behindhand. The business of the Electric Gas Lighting Company is very good also upon the "Coast."

The American Circular Loom Company, of Boston, Mass., has received from the Kansas City (Mo.) Packing Company a letter commending the superior qualities of the American company's insulation. The letter states that the wires were run through buildings where the covering was exposed to strong ammonia fumes for some time without the slightest trace of harm to the insulation. The Oak Grove Farm Company, of Boston, has also written the American company a commendatory letter. At the works of the Oak Grove Company, where the wires run through its refrigerating buildings, the insulation is alternately exposed to heat and cold, so far without any ill effects to the wires.

The Sun Arc Light Company, of 203 South Canal street, Chicago, has recently enlarged to a considerable extent its manufacturing facilities, and is now prepared to fill orders more promptly than ever before for the Sun arc lamp, either for incandescent or arc light circuits. The Great Western Electric Supply Company has secured the general agency for the West. Although this lamp has been on the market but a very short time it has come into quite extended use, especially in isolated plants and central stations using the direct-current incandescent system. This company is incorporated with a capital stock of $300,000, and in addition to its lamp business will engage extensively in the manufacture and introduction of several new electrical appliances upon which patents have been secured.

The Sioux City Engine Works reports a constant improvement in its business, as indicated by an increased number of orders. The company is still continuing its night force, and the indications are that it will be very largely increased in order to keep up the record, so far unbroken during the past season, of shipping everything ahead of contract time. The Sioux City Engine Works has recently shipped and is now erecting two 12-inch × 22-inch and 36-inch compound condensing engines for the Waco Electric Light and Railway Company, Waco, Tex., and one 9-inch × 14-inch Giddings automatic for electric lighting at Sioux City, Iowa. Among the orders booked for electrical installations the past week are one 18-inch × 36-inch for the Dubuque Electric Street Railway, Dubuque, Iowa; one 18-inch × 36-inch for Le Mars Water and Electric Light Company, Le Mars, Iowa. The company also reports having received several inquiries for its new large 24-inch × 48-inch Corliss engine of recent design and pattern, which has been improved and made especially strong for the electric railway trade.

The United States Mineral Wool Company, of 2 Cortlandt Street, N. Y. City, has issued a circular describing the corrugated copper gaskets which it manufactures under United States patent No. 222,388, and giving in addition the prices for the various sizes. In describing this gasket the company says: "This metallic gasket may be used in place of rubber or other destructible materials in general use for packing. It consists of thin sheet copper stamped with concentric corrugations. Three to six corrugations are all that are necessary, so that the space within the bolt holes determines the width of the gasket. In cases where the flanges are thin, and for this reason liable to bend when the bolts are tightened, it is advisable to extend the copper gasket to the full width of flange. This will of course require the cutting of bolt holes in the gasket. Connections made with these gaskets will not blow out after continued use, for each corrugation makes the entire circle of the flange, and so long as the contact is kept complete by compression the joint cannot leak. This gasket never blows out like rubber. It may be put in place while steam is leaking through the valve. It answers well on pipes in which steam is alternately on and off, for it is not impaired by the repeated expansion and contraction. The company is also sending out a card containing a sample gasket.

The Ball Engine Company, of Erie, Pa., has recently made the following sales of apparatus: Reading & Southwestern Street

Railway Company, of Reading, Pa., two 125 h. p. engines; the Key West Gas and Electric Light Company, of Key West, Fla., one 150 h. p. tandem compound engine, one 100 h. p. tandem compound engine, one 60 h. p. tandem compound engine, two 150 h. p. boilers, one 300 h. p. Wheeler condenser, one 300 h. p. Davidson air and circulating pump, one 300 h. p. Davidson boiler feed pump and one 300 h. p. Korting injector; the Trenton Lamp Company, of Trenton, N. J., one 35 h. p. engine; the Johnson Company, of Johnstown, Pa., three 150 h. p. engines, one 300 h. p. cross compound engine; Frishmuth Bros. & Co., of Philadelphia, Pa., one 25 h. p. engine; the Gambrinus Stock Company, of Cincinnati, O., one 25 h. p. engine; Bennett, Sloan & Co., of New York City, one 25 h. p. engine; Allentown Rapid Transit Company, of Allentown, Pa., two 125 h. p. engines; Lebanon Street Railway Company, of Lebanon, Pa., one 50 h. p. tandem compound engine; Edison General Electric Company, of New York City, one 80 h. p. engine; E. T. Copeland & Co., of New York City, three 80 h. p. engines and one 25 h. p. engine; Schuylkill Electric Railway Company, of Pottsville, Pa., one 125 h. p. engine; Durham Electric Light Company, of Durham, N. C., one 80 h. p. engine and boiler; Amsterdam and Brocton Street Railway Company, of Amsterdam, N. Y., one 100 h. p. tandem compound engine; Corvallis Electric Railway Company, Corvallis, Wash., one 150 h. p. tandem compound engine; Olean Electric Light Company, of Olean, N. Y., one 150 h. p. tandem compound engine; Boston and Great Falls Electric Light and Power Company, of Great Falls, Mont., one 150 h. p. engine, and the Northwestern Electrical Supply Company, of Tacoma, Wash., one 25 h. p. engine.

Business Notices.

The Hine Eliminator Co., 106 Liberty street, New York, whose eliminator demonstrated the highest efficiency in the recent competitive test of steam separators made at Sibley College, Cornell University, will send the full official report of the test, with drawings, etc., to all who will send their address. To those troubled with wet steam this report will be of especial interest.

Delightful Resorts.—Our readers who are desirous of finding pleasant places to spend the summer should bear in mind that the Chicago & Northwestern Railway furnishes every facility for a rapid, safe and comfortable journey from Chicago to Waukesha, Madison, Lake Geneva, Neenah, Marquette, St. Paul, Minneapolis, Duluth, Ashland, Lake Minnetonka, Yellowstone National Park and the mountain resorts of Colorado and the far West. Fast vestibuled trains, equipped with reclining chair cars, parlor cars, palace sleeping and dining cars, afford patrons of the Northwestern every luxury incident to travel by a first-class railway. Excursion tickets at reduced rates and descriptive pamphlets can be obtained upon application to any ticket agent, or by addressing W. A. Thrall, general passenger and ticket agent, C. & N. W. Ry., Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JULY 28, 1891.

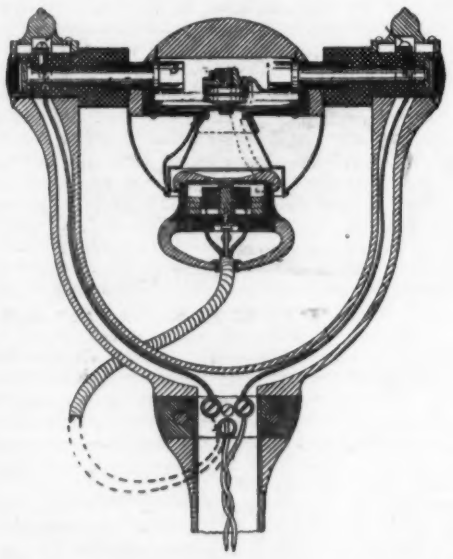
456,558. Electrode for Secondary Batteries; Otis C. Flick, of Brooklyn, Assignor to the Wellington Manufacturing Company, of New York. Application filed Jan. 3, 1887. The method of making electrodes for secondary batteries, consisting in casting or placing pure metallic lead into apertures, cavities or recesses upon the surface of a plate composed of a metal or alloy that is not affected injuriously by the exciting liquid of the battery, then converting the pure metallic lead into a carbonate of lead, and then converting said converted pure metallic lead into lead of a spongy or granular nature while held in the cavities or apertures or upon the surface of the plate.

456,574. Span-Wire Insulators; Walter S. Jarboe, William P. Siebert and John White, of Allegheny, Pa. Application filed Nov. 28, 1890. A span-wire insulator consisting of a block of insulating material having pins entering transversely therein and connected at their outer ends to form a connection from which the trolley wire is suspended.

456,593. Regulation of Dynamos Driven by Compressed Air; Victor Popp, of Paris, France, Assignor to the Popp Compressed Air and Electric Power Company, Limited. Application filed April 7, 1888. For supplying electricity from a general system of compressed-air distribution, the combination of an inlet pipe leading immediately to a drain or siphon, a combined air and electrical automatic regulator placed along said pipe at a point beyond the siphon, a heater for the compressed air, a meter placed between the regulator and the heater, a motor operated by the air after passing the heater, and a dynamo electric machine driven by said motor and having its output controlled by said automatic regulator.

456,598. Electric-Arc Lamp; Francois Louis Sautter, of Paris, France, Assignor to Sautter, Harle & Co., of same place. Application filed Dec. 18, 1890. In an electric-arc lamp, an electromotor for regulating the relative positions of the electrodes, a lever in the circuit of said motor to make and break said circuit, and a device for controlling the position of said lever, consisting of a wire or piece of material sensitive to the heat or light of the arc and adapted to move the said lever.

456,600. Span-Wire Insulator; William P. Seibert, of Allegheny, Pa., Assignor of two-thirds to Walter S. Jarboe and John White, of same place. Application filed Dec. 13, 1890. This invention comprises, generally stated, an insulator consisting of an outer casing of suitable metal, having a series of teeth or projections formed around the mouth thereof, said teeth engaging with a block of insulating material contained within said casing and acting to retain said block within said casing.



No. 456,817.—Electric Circuit-Changing Apparatus.

456,611. Cable-Head for Electric Wires; Upton H. Balsley, of Philadelphia, Pa. Application filed Jan. 12, 1891. A terminal head for electric cables, consisting of a box into which one end of the cable passes, a frame at the top of the box above the end of the cable, one portion of which is inclosed within the box and the other portion exposed on the outside of the box, and permanent electrical connections through the said frame, terminating upon the outside of the box for connections with external wires and terminating at the inside of the box for connections with the wires of the cable within the box is entirely sealed against atmospheric changes. (See illustration.)

456,612. Electromotive Force Regulator; Edward M. Bentley, of Boston, Mass. Application filed Oct. 21, 1890. The method of regulating electric generators or motors, which consists in dividing them into two sources of electromotive force and completing the circuit of each source through a variable portion of the other source.

456,622. Magnetic Separator; David E. Lain, of Yonkers, N. Y. Application filed Aug. 2, 1890. In a battery of magnets for a magnetic separator, the combination of a hollow cone of magnetic metal, two spiral rows of projections of magnetic metal from the external surface of the cone to form the cores for the electromagnets, windings of insulated electrical conductors for each of the cores, and a continuous spiral pole for each of the two rows of cores.

456,667. Spout-Alarm for Grain-Bins; Walter G. Adams, of Racine, Wis., Assignor of one-half to the E. H. Pease Manufacturing Company, of same place. Application filed Dec. 13, 1889. The invention consists in applying a valve to the spout, which is turned by the flow of grain through the spout, but closes automatically when the stream of grain ceases, thereby setting off an alarm either when the discharge through the spout is stopped or when it begins, according to the circumstances of the case.

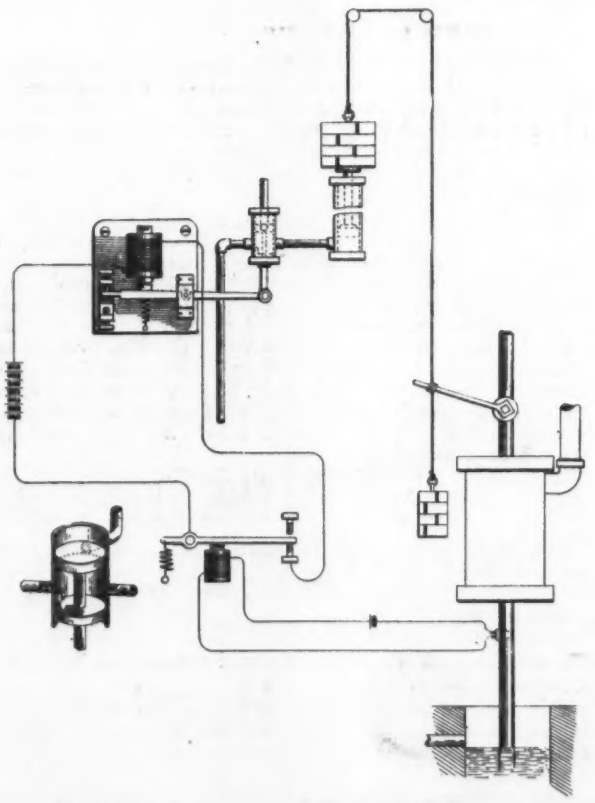
456,684. Electric Gas-Lighter; Adolph Wunderlich, of Cleveland, O. Application filed April 7, 1890. In an automatic electric gas lighting and extinguishing device, a single electric circuit, electromagnets energized by said circuit, an armature attracted by said electromagnets and fastened to a stem, a stem connected to a valve, a valve controlling the flow of gas, a cam operating said stem, valve, and armature, and a pin fastened to said stem.

456,685. Automatic Electric Gas-Lighter; Adolph Wunderlich, of Cleveland, O. Application filed Dec. 5, 1890. The combination, with a burner case having an opening closable by a puppet valve, of a puppet valve connected by a socket joint, an armature connected to said valve by said socket joint, two pairs of electromagnets arranged to act inversely on said armature, and a frictional spring capable of holding said valve and armature wherever placed.

456,746. Medical Induction Coil; Henry A. Voelkner, of Detroit, Mich. Application filed Jan. 28, 1891. A medical battery having, with the induction coil, two current breakers of different rapidity arranged in series in the primary circuit.

No. 456,611.—Cable-Head for Electric Wires.

456,803. Annunciator; William C. Dillman, of Brooklyn, Assignor to Owen Walsh, of New York. Application filed May 6, 1891. An annunciator for speaking tubes, consisting of a swinging leaf arranged at the mouth of the tube and carrying a mouth piece, a catch to hold the leaf in a raised position, means for releasing the catch, and an electric bell arranged in a circuit which is closed by the dropping of the leaf.



No. 456,835.—Electric Condenser Regulator.

456,804. Alternating-Current Motor; Michael Von Dolivo-Dobrowolsky, of Berlin, Germany, Assignor to the Allgemeine Elektricitäts-Gesellschaft of same place. Application filed Dec. 23, 1890. An electric motor, comprising an iron body constituting a field magnet, a number of conductor bars passing through the said body and insulated therefrom, means for conductively connecting all the said bars together at one end, electric circuits, the terminals whereof are connected to the other ends of the said bars, and means for exciting in the said circuits differential-phase alternating currents.

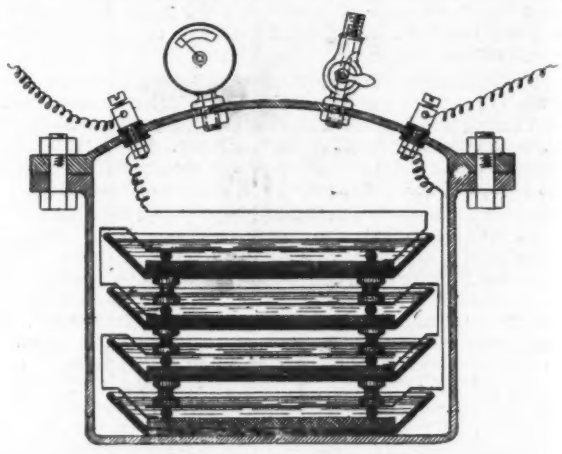
456,817. Electric Circuit-Changing Apparatus; Hammond V. Hayes, of Cambridgeport, Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed Feb. 3, 1891. The combination with an electric circuit and an instrument connected therewith, the said instrument being hung or journaled on bars which project thereinto, constituting terminals of the said circuit and adapted to be placed in one position when employed and in another when unemployed, of an electric-changing switch controlling the connection of said instrument with said circuit having fixed and movable elements, the fixed elements being the said projecting ends of the said bars which constitute the said circuit terminals, one or both of said bars ends having in their circumferential surface a non-conducting section, and the movable elements consisting of contact-springs fixed to the instrument and constituting the terminals thereof, the free ends of said springs being in pressure contact with the circumferential surface of the said fixed elements and adapted to rest on the conducting section thereof when the instrument is in its resting position and to revolve about the same and to make contact with the conducting portions thereof when the instrument is moved to its working position. (See illustration.)

456,835. Electric Condenser Regulator; James McBride, of Brooklyn, N. Y. Application filed Sept. 24, 1890. The invention consists of a mercurial thermostat placed in the discharge pipe of a condenser, in combination with an electric circuit and relay, which in turn controls a main circuit, including an electro magnet, controlling a valve, which admits water to a cylinder containing a piston. The piston is moved by the pressure of water in one direction and by a weight in the opposite direction, which movement is transmitted to the cold-water injection valve of the condenser. (See illustration.)

456,836. Railway Signaling Device; William Newcomb, of Johnsville, N. Y. Application filed Dec. 20, 1890. A railway signaling device having a signal blade adapted to indicate "danger" or "safety" by its position, supported by a hub pivoted on a vertical support, and counterbalanced by springs in the hub and adapted to be rocked by the impact of a locomotive on mechanism connected with the hub.

456,843. Secondary Battery; Henry Pieper, of Liege, Belgium. Application filed Oct. 17, 1888. The method of increasing the capacity of primary and secondary batteries and effecting their depolarization, which consists in maintaining within the battery fluid gases in solution under pressure. (See illustration.)

456,865. Show Stand; John W. Tyler, of Dayton, O. Application filed March 12, 1891. A show stand comprising a shelf, a shaft or rod, and a motor therefor, a segmental circuit-closing device, the moving member of which is connected to and operated by said motor, and electric lamps of various colors connected in groups to the several segments of the circuit closer, so that each group successively shall be thrown into and out of circuit.



No. 456,843.—Secondary Battery.

456,888. System of Electrical Distribution; Morris Feilbogen, of New York, Assignor to Gustav Lindenthal, of Pittsburgh, Pa. Application filed Sept. 22, 1890. In a system of electric distribution, a constant electric generator and an inductorium or a series of the same, a series of circuit breakers having their brushes connected with the primary coils of the inductoriums, a series of brake levers by which the circuit breakers are regulated, a driving shaft having a pulley connected with the motor by which the dynamo is driven, and a series of pulleys connected with the pulleys of the disrupters or circuit breakers by means of suitable bands.

456,889. Electric-Circuit Breaker for Secondary Generators; Morris Feilbogen, of New York, Assignor to Gustav Lindenthal, of Pittsburgh, Pa. Application filed Sept. 22, 1890. A circuit breaker or disrupter, having a disc constructed of insulating material carrying a series of segments in electrical connection with its shaft, a brush secured to an insulated seat, a weighted brake lever having a curved spring-plate bearing against the periphery of the disc, a hollow coil having its terminals in the main circuit, and a movable core secured to the brake lever and setting in the coil, whereby the lever is operated as a brake to control the movement of the disrupter.

456,908. Electric Hoisting Machine; George H. Reynolds, of New York, Assignor to the American Electric Elevator Company, of same place. Application filed Dec. 27, 1890. A hoisting apparatus, having a series of contacts and a rheostat in an electrical circuit, a switch arranged to traverse said contacts, and an electric motor adapted to receive a greater or less electromotive force therethrough, a worm driven from the shaft of said motor, a worm wheel meshing with said worm and carrying frictional contact surfaces, a central shaft upon which the worm wheel is fixed, having one end threaded, a winding drum having frictional surfaces to correspond with those on the worm wheel, and a sleeve carried loosely upon the central shaft, a hand wheel working upon the screw of the shaft, and a clamp for joining said hand wheel to said sleeve, so that they may move together laterally and revolve together or independently.

456,925. Armature for Motors and Generators; Norman C. Bassett, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Feb. 27, 1891. An ironclad armature having longitudinal holes or perforations near its periphery, or surface coils wound through and partly filling said holes, and a wedge or wedges of insulating material driven into said holes so as to compress the coils and bind them within the holes.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.